

*IMPACT OF KOKOMO BY-PASS
FROM 1950 TO 1964*

AUGUST 1965

NO. 11

*Joint
Highway
Research
Project*

by
E.G. EVANS

**PURDUE UNIVERSITY
LAFAYETTE INDIANA**

IMPACT OF KOKOMO BY-PASS
FROM 1950 TO 1964

To: G. A. Leonards, Director
Joint Highway Research Project

July 9, 1965

From: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-64A
File: 3-5-1

The attached report entitled "Impact of Kokomo By-Pass from 1950 to 1964" has been authored by Mr. Eugene Evans, Graduate Assistant on our staff. The research was conducted by Mr. Evans under the direction of Professor H. L. Michael. The report is submitted as a progress report on the Highway Impact Studies Project, a part of the HPR-RPS work program.

Mr. Evans also used the report as his thesis for the MACE degree.

The report is submitted for the record and will be transmitted to the Indiana State Highway Commission and to the Bureau of Public Roads for review and comment.

Respectfully submitted,

H. L. Michael

Harold L. Michael, Secretary

HLM:bc

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by

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Project: C-36-64A
File: 3-5-1

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

In cooperation with

Indiana State Highway Commission

and

Department of Public Roads
U. S. Department of Commerce

Not Withdrawn For Publication
Subject as Designated

Not Reviewed By
Indiana State Highway Commission
or the
Bureau of Public Roads

Purdue University
Lafayette, Indiana
July 9, 1965

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Bureau of Public Roads

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ACKNOWLEDGMENTS

The author wishes to express his sincerest appreciation to Professor Harold L. Michael, Professor of Civil Engineering and Associate Director, Joint Highway Research Project for his assistance and recommendations throughout the study and review of the manuscript. He also wishes to acknowledge the assistance of the Indiana State Police who provided information for the accident study, personnel of the offices of the Howard County Auditor and Recorder for invaluable cooperation in obtaining the land value data, the Kokomo City Plan Commission and the Howard County Plan Commission for their suggestions and advice.

Thanks are also extended to Jon Whitworth, to the draftsmen, to part time labor, and to the typists for their effort, patience, and understanding.

The author is grateful to the Joint Highway Research Project for the use of facilities and equipment which made this project possible. He also wishes to express thanks to the Bureau of Public Roads and the Indiana State Highway Commission for their financial support of this project.

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ABSTRACT

Evans, Eugene Glen, MSCE, Purdue University, August, 1965. Impact of Kokomo By-Pass From 1950 to 1964. Major Professor: Harold L. Michael.

The purpose of this study was to determine the "long-range" effects of a noncontrolled urban by-pass. This research was concerned with the impact that the U.S. 31 By-pass at Kokomo has had on traffic volumes, travel times, accidents, land use, and land value.

Travel time, volume, and accident data illustrate the trends from 1951 through 1964. Traffic movement characteristics at the major intersections along the by-pass are shown on turning movement diagrams. An economic analysis of the travel times and accident rates on the by-pass indicated that a sizeable economic loss has been absorbed by the motorist because the Kokomo By-pass was not constructed as a fully controlled access facility.

The land use growth pattern indicated that a large percentage of the development directly adjacent to the by-pass is industrial and commercial. Subdivisions have also been platted and developed adjacent to the by-pass. Land use

trends indicated that the major growth of Kokomo is occurring to the east and in the vicinity of the by-pass.

Land value changes have resulted as a direct consequence of the Kokomo By-pass. Land on the city side of the by-pass has shown the most pronounced increase in value while all land within the study area has shown some increases. The most significant increase in land value has occurred when land was changed from one land use to another.

A portion of this study was devoted to an analysis of the partial taking of property for right-of-way purposes. The objective of this portion of the study was to provide additional knowledge in property damage and enhancement resulting from highway improvements.

INTRODUCTION

The mobility of man has dictated his well-being from the beginning of time. His first means of transportation was by foot, but this greatly limited his radius of influence. Soon the advantage of transport by water was discovered, and this was followed by domesticating the beast to transport man from origins to his desired destinations. The latter form of transportation enabled the human to travel in almost any direction, but the quantity of supplies which he could transport was, at best, quite limited. The wheel was the next, and possibly the most significant transport invention. It enabled man to move vast quantities of goods with beasts of burden supplying the power for mobility.

Rail service became available with the invention of the steam locomotive and resulted finally in the first transcontinental mode of travel. This type of transport, however, failed to satisfy man's individual needs, and he was stimulated into developing machinery which resulted in the motor vehicle. Finally, innovators, scientists, and engineers were intrigued by the bird, and through a concentration of intellectual knowledge they moved into the

skies and even space with air-borne craft.

What lies ahead in the transportation era? Will it be a trip to a distant planet? Will it be conveyance by a tube, or will it be some other, as yet unknown, mode of transportation?

All of the problems of transportation by current means of movement, however, have not been solved. With the advent of the automobile has come the problem of inadequate highway networks. From the very beginning the automobile industry forged ahead of the highway program until its "tin lizzies" were often stuck in the mud. Today, traffic jams threaten to strangle the urban areas.

One look at the countries of the world, as they exist today, will answer the question as to which nations have achieved the highest economic level. Another look will satisfy one that the efficiency of the transportation system correlates well with the economic prosperity of a country. Without an intricate and balanced transportation system, specialization, competition, mass production, and other elements that contribute to prosperity would be limited if not impossible.

Highway administrators and engineers have only limited resources and revenues on which to implement highway programs, and it is paramount that the most efficient and economical procedures be followed. It must also be recognized that there are other public services, such as schools, recreational programs, etc., competing for the limited funds

and that it is essential to have a sound, and not extravagant, highway program. Studies, therefore, are needed to supply information which will enable administrators and engineers to make wise decisions.

Because of the tremendous increase in population and vehicle registration, the traffic problem within urban areas has become particularly acute. A solution to alleviate this congestion problem in the central portion of small to medium sized cities has been to provide by-passes for primary routes which originally penetrated to the heart of the city. After a by-pass has been deemed desirable for a city, the questions arise as to which type of facility and design should be provided. Should intersections be separated? Should access be permitted or prohibited? Will a fully controlled access arterial act as a barrier to future urban growth? These are only a few of the questions which must be considered.

In order to help answer the questions posed several studies have been or are being made of the accident experience, traffic volumes, speed and delay, and other factors of by-passes. The study reported herein was designed in part as such an investigation. From the results of such a study comes information which can profitably be used when planning new urban by-pass facilities.

THE IMPACT STUDIES

This study of the Kokomo By-pass is only one part of a six phase highway impact project which was initiated on July 1, 1960, by the Joint Highway Research Project at Purdue University (7)*. The project was tentatively scheduled to extend over a period of ten years, and during this time information relevant to the impact of six highway improvements was to be studied.

Six types of highway improvements were selected to comprise the study areas. These facilities, all of which are major highways, are as follows:

- Facility 1. An urban by-pass with complete access control;
- Facility 2. A rural highway with complete access control;
- Facility 3. An urban by-pass with little or no access control;
- Facility 4. A rural highway with little or no access control;

* Number in parentheses refers to listings in the Bibliography.

Facility 5. A bridge and its approaches in an urban area;

Facility 6. A major highway interchange near a metropolitan area.

The specific facilities which correspond to the improvements listed above are as follows (see Figure 1):

Facility 1. The Interstate 65 By-pass around Lebanon, Indiana;

Facility 2. A thirteen mile portion of Interstate 65 from the south end of the Lebanon By-pass to the interchange with Interstate 465 northwest of Indianapolis, Indiana;

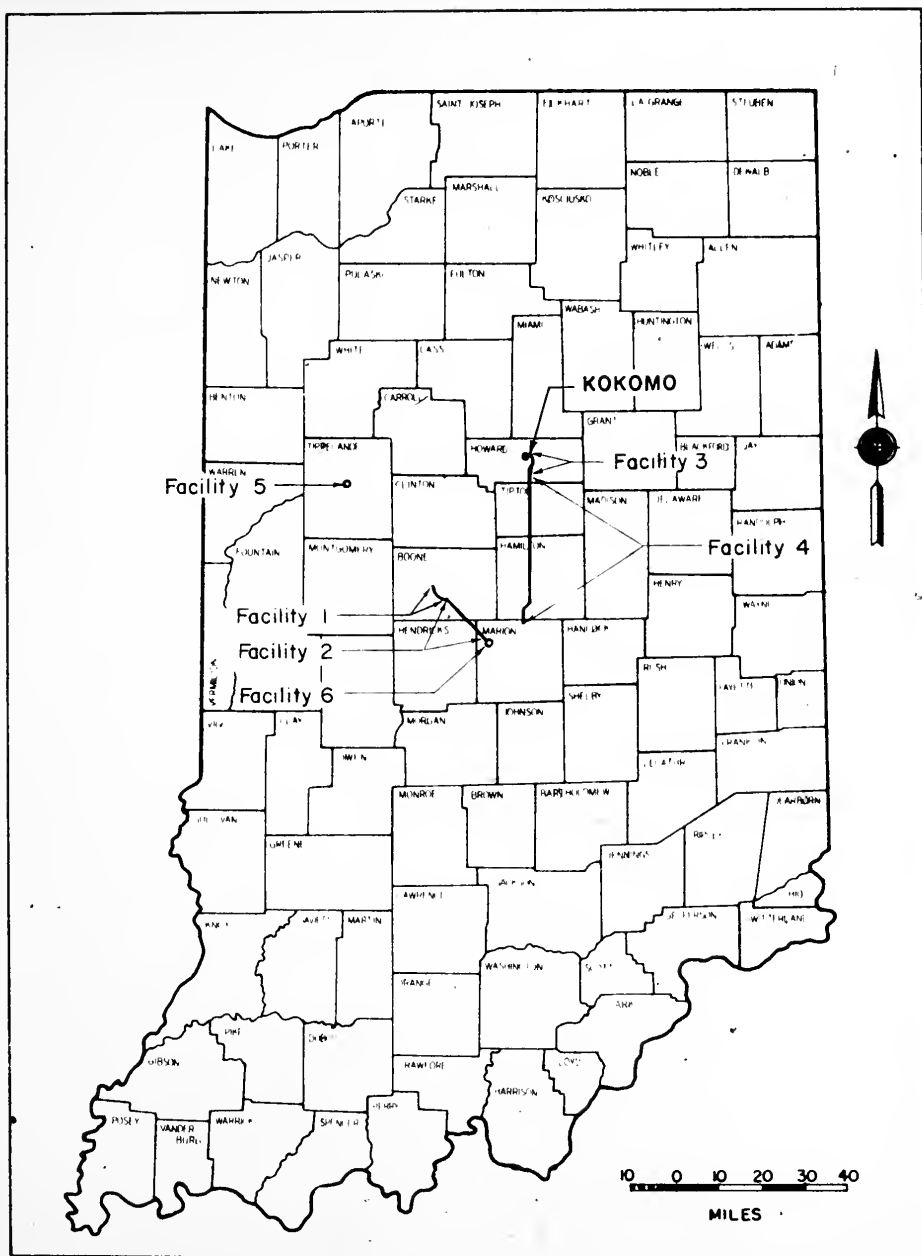
Facility 3. The U.S. 31 By-pass around Kokomo, Indiana;

Facility 4. U.S. 31 from the south end of the Kokomo By-pass to the north edge of Marion County, Indiana;

Facility 5. The U.S. 231 Bridge over the Wabash River connecting Lafayette and West Lafayette, Indiana;

Facility 6. The interchange connecting Interstate 65 and Interstate 465 northwest of Indianapolis, Indiana.

Facilities 1, 2, and 6 are continuous portions of Interstate 65 extending from the north edge of Lebanon to approximately eight miles northwest of the Central Business District of Indianapolis. Facilities 3 and 4 are continuous



LOCATION OF STUDY FACILITIES

Figure 1

portions of U.S. 31 extending from the north end of the Kokomo By-pass to the north edge of Marion County.

A study of facility 2 was conducted and submitted in June, 1961 (8,9). A report on facility 5 was completed in May, 1962 (13). In October, 1964, a report was submitted on facility 1 (12). This study is concerned with facility 3.

SCOPE AND PURPOSE

The purpose of this investigation was to study the "long-range" effects of a by-pass with little or no access control. A study of this type brings into perspective the desirable and the undesirable characteristics of a by-pass without full control of access.

Since the original highway improvement of the Kokomo By-pass was in 1950, changes in both land value and land use were observed. Trends in the operational characteristics of the facility were studied since similar changes are likely to occur on other by-pass routes where access is not controlled.

An equitable value for land taken for the right-of-way for a new or relocated highway is difficult to determine, and in the past much controversy has arisen over this matter. Studies were made of land value with time and with relation to the distance from the by-pass. A parcel analysis of tracts involved in partial takings was also made. The objective of this analysis was to determine if both the property owner and the state had been equitably treated. This information is of interest to state highway authorities in determining fair values for future parcels taken for highway improvements.

THE STUDY AREA

Kokomo, as a city by that name, has a history dating back to 1844. Prior to this date the area was a center of trade for many local Indian tribes. The original development was located along the meandering Wildcat Creek which worms its path through Howard County. The creek doubled as both water supply and a means for transporting food and goods for the early settlers.

Kokomo, centrally located in Howard County, was chosen as the county seat late in 1844. The young city's primary function was to serve as a center for trade, judicial, and administrative activities. In 1853 the first railroad right-of-way cut through the heart of the settlement and provided another mode of transportation. With the discovery of a natural gas deposit in 1886 and the availability of water, rail, and highway transportation, rapid industrial growth occurred. The "boom" was short lived, however, as the natural gas supply soon was exhausted. Some industries, as a result, were forced to close their doors permanently and semi-disaster followed for Kokomo's economy and livelihood. The city was revitalized soon after the turn of the century, as industry associated with the new motor vehicle made

Kokomo a center of production.

After World War I a program was initiated to attract additional industry, and the effort was met with reasonable success. Employment increased and the economic picture brightened until the national depression engulfed the country in 1929. Many businesses and industrial establishments failed. The next few years spread hardship throughout Kokomo as conditions were similar to the general status that prevailed throughout the nation.

The effects of the depression were not entirely obliterated until World War II began, although some industrial activity began to revive late in the 1930's. With the bombing of Pearl Harbor, the United States was thrust into the War, and most of Kokomo's industrial establishments directed their effort to manufacturing war commodities. Since World War II a number of expanding and new industries have brought an employment increase and a thriving economy to Kokomo.

Physiographic characteristics in Howard County can best be described as Wisconsin Ground Moraine which covers the central portion of Indiana. The area is flat to gently rolling, and throughout the flat portions of the county drainage is a problem.

Kokomo is situated in north central Indiana on a major north-south highway, U.S. 31 (see Figure 2). U.S. 35 connects the city to other metropolitan areas to the northwest and southeast while Indiana 22 passes in an east-

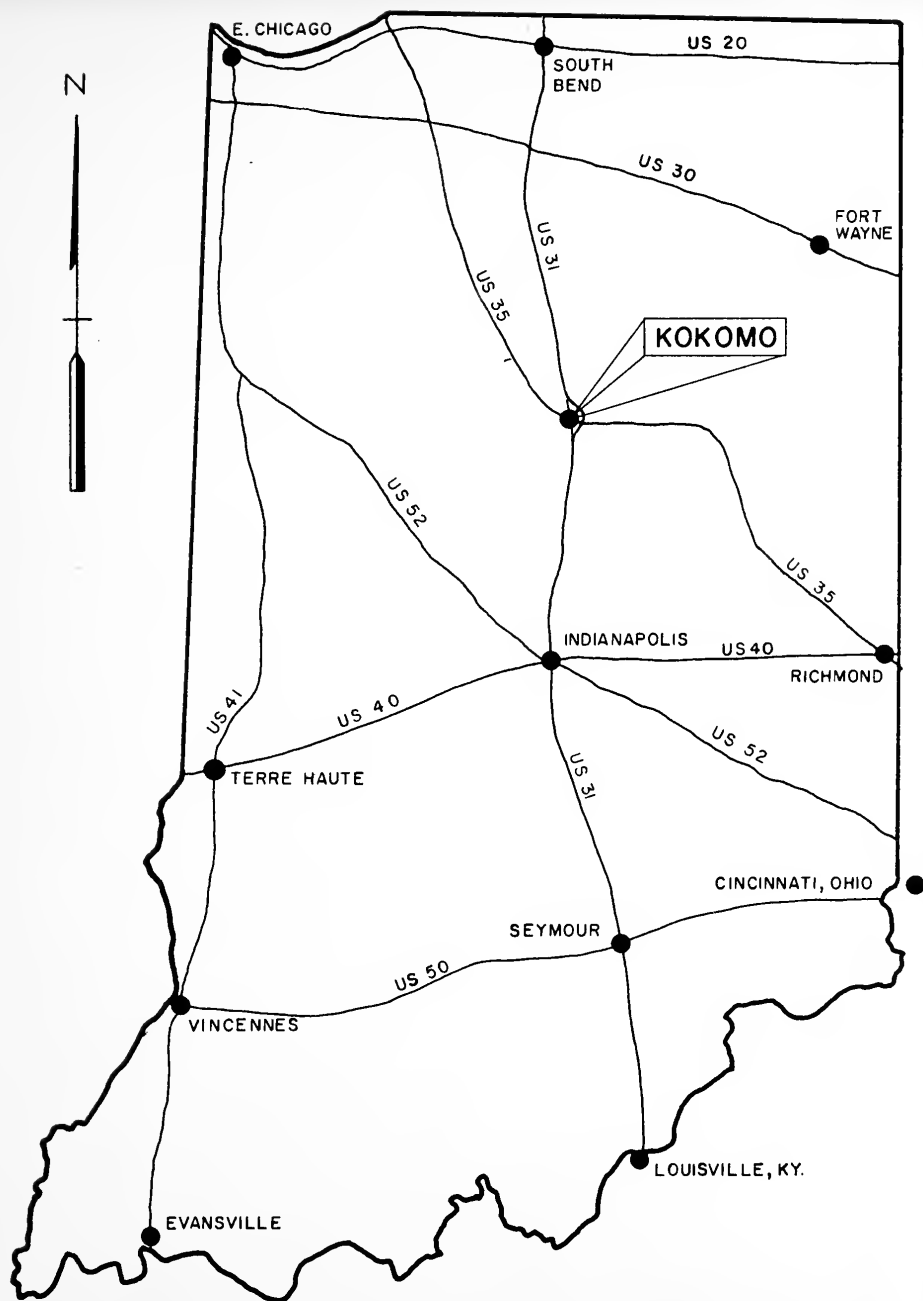


FIG. 2 - LOCATION OF KOKOMO IN INDIANA

west direction through the city. Kokomo is 50 miles north of Indianapolis, 77 miles south of South Bend, 145 miles from Chicago, and 162 miles from Cincinnati. Figure 3 is a mosaic of the Kokomo area showing the developed area and the location of the by-pass and other major transport routes. The major transportation routes for Kokomo are further illustrated in Figure 4.

Three railroad lines provide service to Kokomo of which two are the property of the Nickel Plate Railroad, and the other is property of the Pennsylvania Railroad. Both passenger and freight rail service are available with ten freight trains and two passenger trains passing through the city daily. Faster passenger service is available at the Municipal Airport which is served by a commercial airline. Six flights are scheduled daily to such metropolitan areas as Chicago, Detroit, Lima, and Cincinnati. Kokomo is also served by three bus lines of which one is local, one offers service within Indiana, and the third provides passenger service to all segments of the nation. Thirteen trucking agencies which are located in Kokomo offer their services to the inhabitants and to the industrial and commercial establishments in the greater Kokomo area.



FIGURE 3 - MOSAIC OF KOKOMO AND THE U.S. 31 BY-PASS

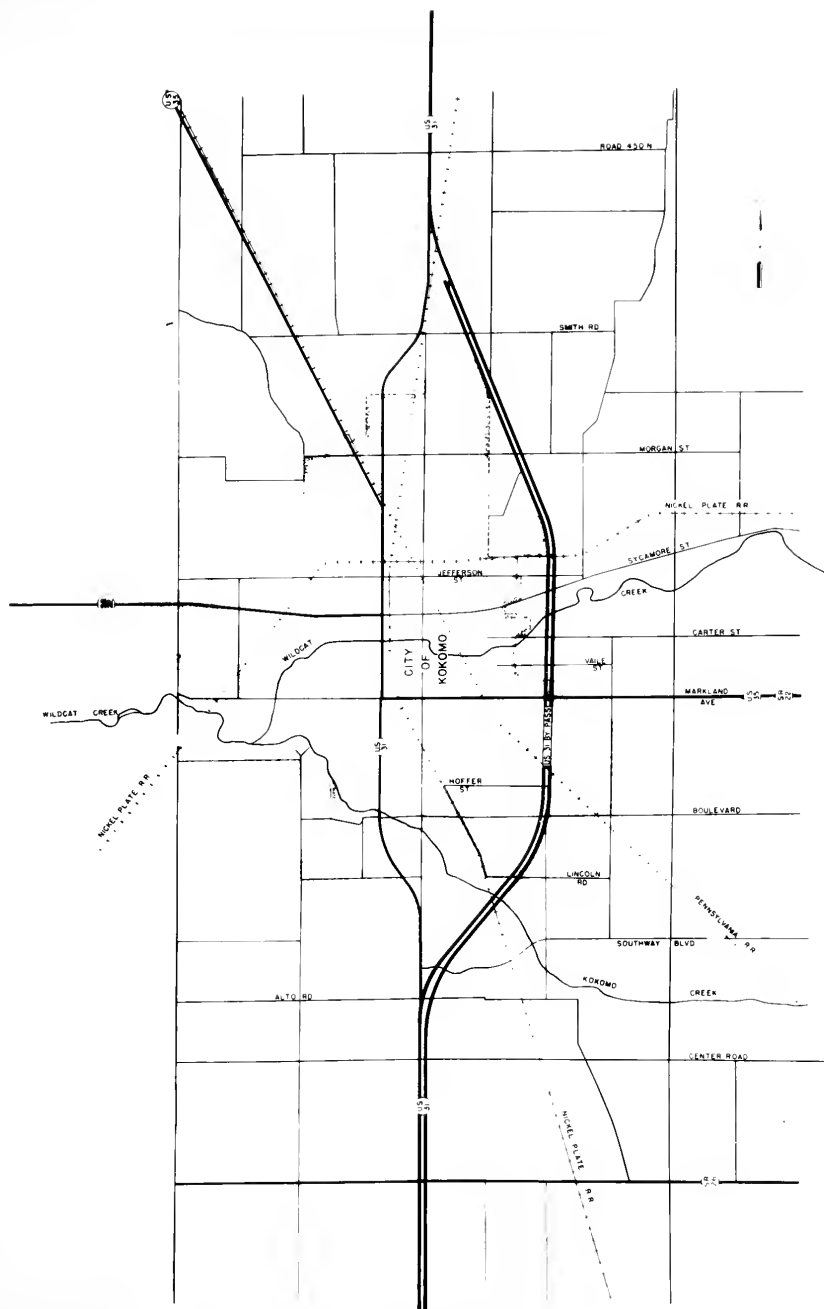


FIGURE 4 - MAJOR TRANSPORTATION ROUTES IN KOKOMO AREA

HOWARD COUNTY

The rural portion of Howard County is predominantly fertile farmland which provides farm inhabitants a prosperous livelihood. Howard County, however, is classified as urban since over 80 percent of its population resides within an urban area. Population increases within Kokomo and Howard County have been steady (see Figure 5) and greater than the prevailing trend in Indiana.

Statistics for the population distribution, income, labor, housing, retail trade, wholesale trade, manufacturing, and bank deposits are shown for Howard County and the State of Indiana in Tables 1 and 2, respectively (2). Table 3 illustrates the change in the above statistics for Howard County and Indiana for approximately a ten year period. These data show that population, income, labor, housing, and bank deposits for Howard County have increased at a faster rate than the state average while the changes in retail trade, wholesale trade, and manufacturing have been comparable to the state averages.

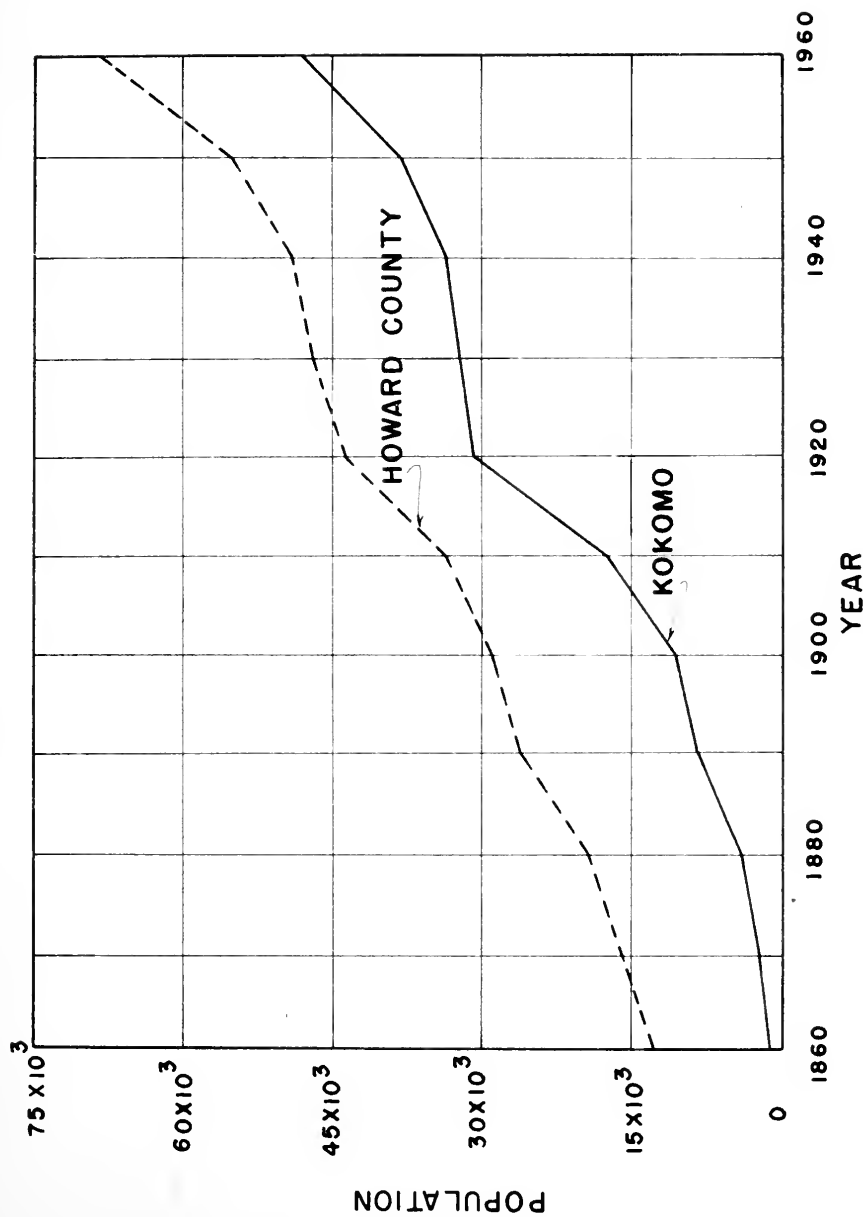


FIG. 5- POPULATION GROWTH OF KOKOMO AND HOWARD COUNTY

TABLE 1

SELECTED STATISTICS FOR HOWARD COUNTY

	<u>1950</u>	<u>1953</u>	<u>1960</u>	<u>1962</u>
Portion of land in farms	94%		91.9%	
Number of commercial farms	1340		1306	
Percent tenant operated	25.3		23.6	
Population	54,493		69,509	
Percent residing on farms	12.6		7.5	
Percent residing in city of Kokomo	71		68	
Number of families	15,070		18,272	
Median family income	\$3,232		\$6,124	
(with price index adjusted to 1960)	(\$3,911)			
Total number on labor force	21,313		25,128	
Percent male	82.9		70.2	
Percent employed in agriculture	8.5		4.3	
Percent employed in manufacturing	47.5		49.7	
Percent employed in wholesale and retail trade	17.5		15.7	
Percent working outside Howard County	NA		4.8	
Percent who are white collar workers	NA		34.6	
Number of firms		987		1,047
Number of employees		22,109		22,754
Housing Units:				
Total occupied	16,468		20,808	
Percent owner occupied	67		73.1	
Median value of owner occupied	\$5,642		NA	
Percent renter occupied	35		NA	
Median gross monthly rent	\$33		NA	

TABLE 1 (continued)

	<u>1947</u>	<u>1948</u>	<u>1950</u>	<u>1958</u>
Retail Trade:				
Number of establishments		611		615
Sales(\$1000)		\$49,365		\$69,969
(Price index adjusted to 1958)		(\$62,693)		
Number of paid employees		2,878		2,718
Wholesale Trade:				
Number of establishments		65		83
Sales (\$1000)		\$22,831		\$43,562
(Price index adjusted to 1958)		(\$28,995)		
Number of paid employees		458		462
Manufacturing:				
Number of employers	94			85
Number of employees	11,626			12,886
Bank deposits:				
Total (\$1000)			\$27,676	\$48,075
(Price index adjusted to 1958)			(\$32,104)	
Time deposits (\$1000)			\$10,098	\$14,761
(Price index adjusted to 1958)			(\$11,714)	

TABLE 2

SELECTED STATISTICS FOR THE STATE OF INDIANA

	<u>1948</u>	<u>1950</u>	<u>1958</u>	<u>1960</u>
Population		3,934,000		4,662,000
Number of families		1,039,000		1,198,000
Median family income		\$3,200		\$5,800
(Price index adjusted to 1960)		(\$3,900)		
Total number in labor force		1,518,442		1,717,241
Number of firms		69,127		80,087
Number of employees		815,012		1,149,400
Housing units - total occupied		1,168,916		1,387,878
Retail trade:				
Number of establishments	44,754		45,904	
Sales (\$1000)	\$3,532,337		\$5,176,591	
(Price index adjusted to 1958)	(\$4,486,068)			
Number of paid employees	192,403		201,800	
Wholesale Trade:				
Number of establishments	5,325		6,697	
Number of paid employees	45,056		58,800	
Sales (\$1000)	\$3,227,141		\$5,230,576	
(Price index adjusted to 1958)	(\$4,098,468)			
Manufacturing:				
Number of employers	5,408		6,556	
Number of employees	548,346		544,347	

TABLE 2 (continued)

	<u>1948</u>	<u>1950</u>	<u>1958</u>	<u>1960</u>
Bank Deposits:				
Total deposits (\$1000)		\$2,759,959		\$4,798,552
(Price index adjusted to 1960)		(\$3,339,550)		
Time deposits (\$1000)		\$923,475		\$1,484,357
(Price index adjusted to 1960)		(\$1,117,405)		

TABLE 3

COMPARISON OF PERCENTAGE CHANGE IN SELECTED STATISTICS FOR
HOWARD COUNTY AND THE STATE OF INDIANA FOR A TEN YEAR PERIOD

	<u>Howard County</u>	<u>Indiana</u>
Population	+ 27.5%	+ 18.5%
Number of families	+ 21.2%	+ 15.3%
Median family income	+ 56.6%	+ 48.7%
Total number in labor force	+ 17.9%	+ 13.1%
Number of firms	+ 6.1%*	+ 15.9%
Number of employees	+ 2.9%*	+ 41.0%
Total number of housing units occupied	+ 26.4%	+ 18.7%
Retail trade:		
Number of establishments	+ 0.7%	+ 2.6%
Number of employees	+ 5.9%	+ 4.9%
Sales	+ 11.6%	+ 15.4%
Wholesale trade:		
Number of establishments	+ 27.7%	+ 25.8%
Number of employees	+ 0.9%	+ 30.5%
Sales	+ 50.2%	+ 27.6%

* 9 year period (Census data for 1953 and 1962 were not consistent)

TABLE 3 (continued)

	<u>Howard County</u>	<u>Indiana</u>
Manufacturing:		
Number of establishments	- 9.6%**	+ 21.2%
Number of employees	+ 10.8%**	- 0.7%
Bank deposits:		
Total deposits	+ 49.7%***	+ 43.7%
Time deposits	+ 26.0%	+ 32.8%
** 11 year period		
*** 8 year period		

THE KOKOMO BY-PASS

In the 1940's the heavy volume of traffic which traversed U.S. 31 through the city was creating congestion, noise, and vibration and was a hazard to the public. Travel times for the motorist were high because of the necessarily slow speeds required to pass through the narrow streets of Kokomo; therefore, the Indiana State Highway Commission constructed a by-pass east of the city in 1950. The by-pass increased the travel distance on U. S. 31 from 6.835 miles to 7.250 miles, but the travel time was decreased considerably for the motorist using the by-pass because of the higher operating speeds.

The by-pass was located in the vicinity of the former Reed Road with the west edge of Reed Road retaining its status as the west edge of the by-pass (see Figure 6). The land use in the immediate area of the by-pass was predominantly agricultural. Enough right-of-way was acquired in the original purchase for the future construction of a four-lane divided facility, but estimated traffic volumes in the early 1950's were such that only two lanes of the by-pass were warranted. The first two lanes constructed were the future north bound traffic lanes of the planned four-lane divided highway. On November 2, 1950, the Kokomo

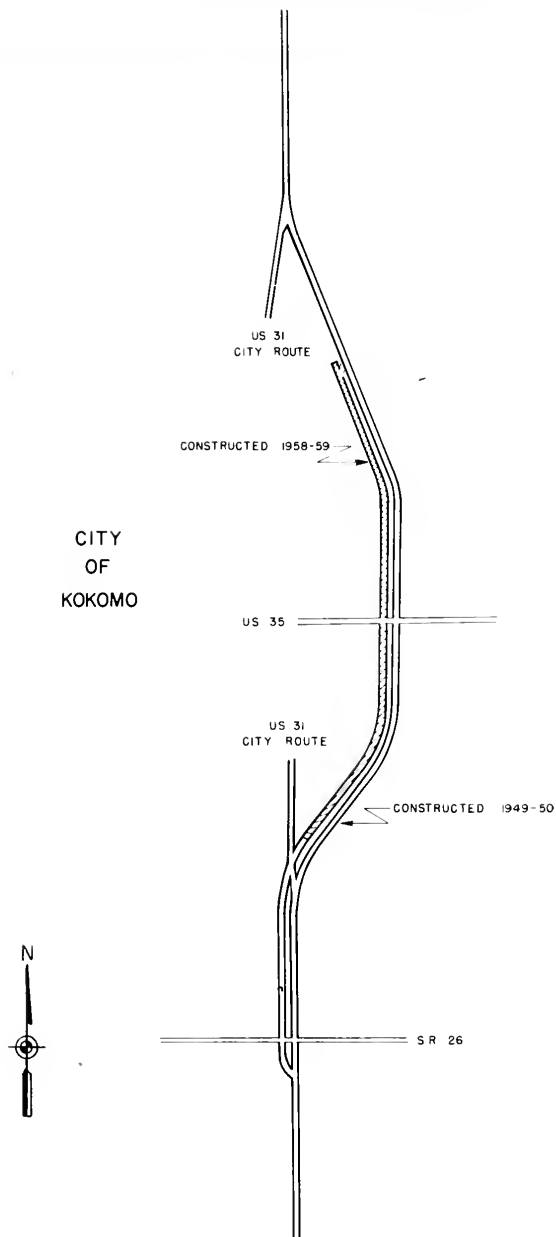


DIAGRAM SHOWING CONSTRUCTION STAGES OF THE U. S. 31 BY-PASS

FIGURE 6

By-pass was opened to traffic.

Considerable development occurred along the Kokomo By-pass from 1950 through 1958 (see Figure 7), and additional traffic volumes were generated. By 1958 the traffic volume warranted the addition of the final two lanes, except for a short section at the north end of the by-pass. On June 16, 1960, the additional two lanes were opened to traffic. The original two lanes constructed in 1950 were 22 feet wide while the final two lanes added in 1960 were 24 feet in width. A median strip 40 feet in width separated the opposing traffic movements.

An aerial photograph taken in 1963 of a portion of the by-pass is shown in Figure 8.



FIGURE 7 - THE KOKOMO BY-PASS IN 1957



FIGURE 8- A PORTION OF THE KOKOMO BY-PASS IN 1963

PREVIOUS STUDIES

The first study of the Kokomo By-pass was conducted in 1950 and 1951 by H. L. Michael (14). This was a "before-after" study of the facility. The purpose of this study was to determine the "early" effects of the by-pass upon traffic, congestion, accidents, land use, land value, and business. This study also revealed the "early" impact of the highway improvement on the growth, development, and general welfare of the city.

A further purpose was a feasibility evaluation of the by-pass. Included in the study was a "before" and "after" origin-destination survey which described travel patterns for the Kokomo area. Data from this analysis also reflected changes in travel patterns. Supplementary to the O-D survey were volume and turning movement counts at inter-sections along the by-pass.

Prior to conducting the O-D survey an imaginary cordon line encompassing the Kokomo city limits was selected so as to define the internal-external boundaries of the study area. The cordon line was selected so as to intersect as few routes as possible.

The after study indicated that approximately 90 percent of the through traffic on U.S. 31 did use the by-pass. A further

analysis of the travel time data indicated a considerable savings in cost and time to the motorist who chose to use the by-pass. A benefit-cost ratio for the Kokomo By-pass versus the city route was shown to be 1.65 in the 1951 study.

Land values in the vicinity of the new facility were found to have increased approximately 50 percent upon completion of the by-pass. This reflected the desire of businessmen to exploit the opportunities afforded by the by-pass. The study indicated that even in the period immediately following the opening of the by-pass, few businessmen on the city route felt that the new facility was detrimental to their business. Some businessmen on the city route even realized an increase in their volume of trade while a few felt that the by-pass decreased their sales volume. This latter group primarily consisted of proprietors of service stations, restaurants, and hotels which depended on the motoring public for their livelihood.

In 1957 another study was conducted by Pinnell on the "later" effects of the Kokomo By-pass (18). His study also included an evaluation of the Lebanon By-pass. This report reflected the "later" effects of noncontrolled access facilities upon travel time, accidents, land use, land value, and business trends. These data were used to evaluate the operational efficiency and economic effects of the by-passes to that date. The study revealed that the operational efficiency of these noncontrolled access by-



passes was inadequate. Travel times and accident rates were found to be much higher than what could have been expected on a fully controlled access facility.

A "long-range" impact study was completed on the Lebanon, Indiana, By-pass in 1964 (12). The objective of this report was to depict "long-term" changes in land value, land use, and travel characteristics caused by a highway improvement and to evaluate the impact of improving that by-pass by adding two lanes and full control of access.

An analysis of the right-of-way costs showed clearly that if access control and grade separations are to be made most economically for a facility, all right-of-way for such improvements should be purchased in the original taking (12). The study also found that a substantial reduction in the accident rate occurred following the reconstruction of the by-pass to interstate standards.

Other land economic studies in several states(4, 6, 14) have indicated that a by-pass skirting the periphery of a city is seldom detrimental to the business establishments along the old route. In fact, most of the studies have indicated that the business potential is actually enhanced along the former route and in the central business district after the through traffic has been removed. Land and property values adjacent to the old route have also experienced an increase in value on most of the facilities studied.

Case studies of remainder parcels after partial taking for the right-of-way of a new facility have been reviewed in several reports (4, 21). These studies indicate that in most cases the property owner of remainder parcels has actually been enhanced because of the new facility. These data manifest that most property owners who retain their remainder parcels for the longest period of time following the construction of a facility are enhanced a greater amount, even after sale values have been adjusted for inflation (22).

TRAFFIC VOLUME

Traffic volume data are necessary in most phases of highway planning and engineering. These data are used in the geometric design of new facilities, in determining appropriate traffic control devices, and in determining the degree of congestion at a given location. The growth of an area is also reflected in traffic volume change with time for a given arterial. Traffic counts over a time period may also be used to determine the trip generating characteristics of establishments.

In the summers of 1960, 1963, and 1964, volume data not heretofore reported were obtained at various locations along the Kokomo By-pass and on streets and drives intersecting this facility. Volumes were not obtained on private residential drives.

The most comprehensive data were collected in 1964 with the aid of four automatic, 15-minute recording, volume counters. One counter was placed at one location on the by-pass during the entire volume counting period. This counter was used as a control while the remaining three counters were placed at various locations along the by-pass until all the desired data were obtained.



The daily volume counts from the control counter were converted to an ADT (average daily traffic) weekday volume with the use of a yearly volume factor curve (see Figure 9). This was done for counts taken during the counting period at the control station as follows:

Average weekday control count for the counting period = x

ADT at control station = $\frac{x}{1.17} = Y$ (see Figure 9 for 1.17 as counts were taken during July and August).

ADT daily factor = $\frac{\text{Daily control count}}{Y} = Z$

ADT counts at each location where traffic was counted were then computed as follows:

ADT count at a station = $\frac{\text{Daily count at that station}}{Z}$

where the Z used was for the day of the count.

The above technique was used to translate field volume counts into ADT weekday volumes which are the values most often utilized in design and traffic analyses.

Volumes in 1951 for the Kokomo By-pass and major intersecting streets are shown in Figure 10. When these are compared to the corresponding volumes in 1964 (see Figure 11), a sizeable increase in volumes is noted. Figure 12 shows pictorially the volumes at minor intersections and access points along the by-pass. Increases in traffic volumes from 1951 through 1964 for selected locations on the by-pass and on streets intersecting the facility are also shown in Tables 4 and 5.

With large traffic volume increases have come traffic signals at several intersections, congestion, increases in



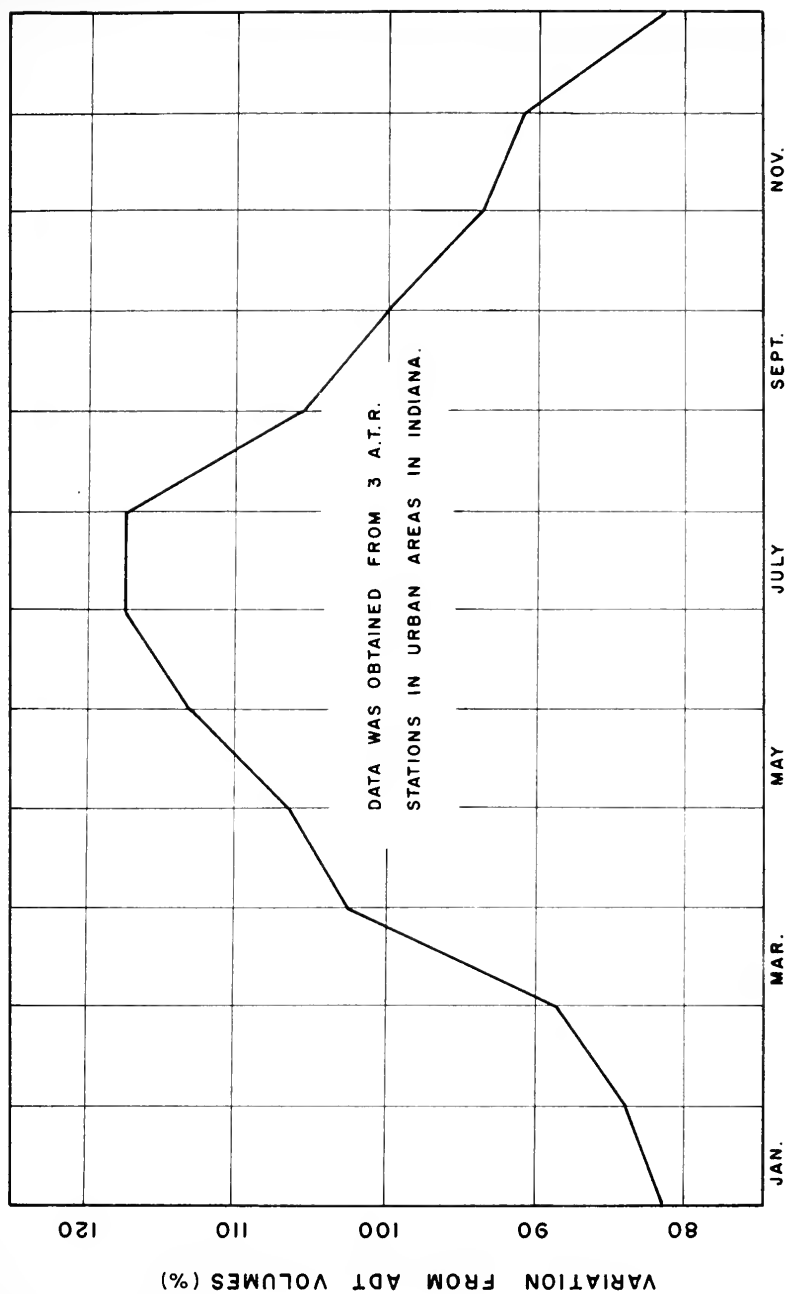


FIG. 9- VOLUME FACTORS FOR MONTHS OF THE YEAR.



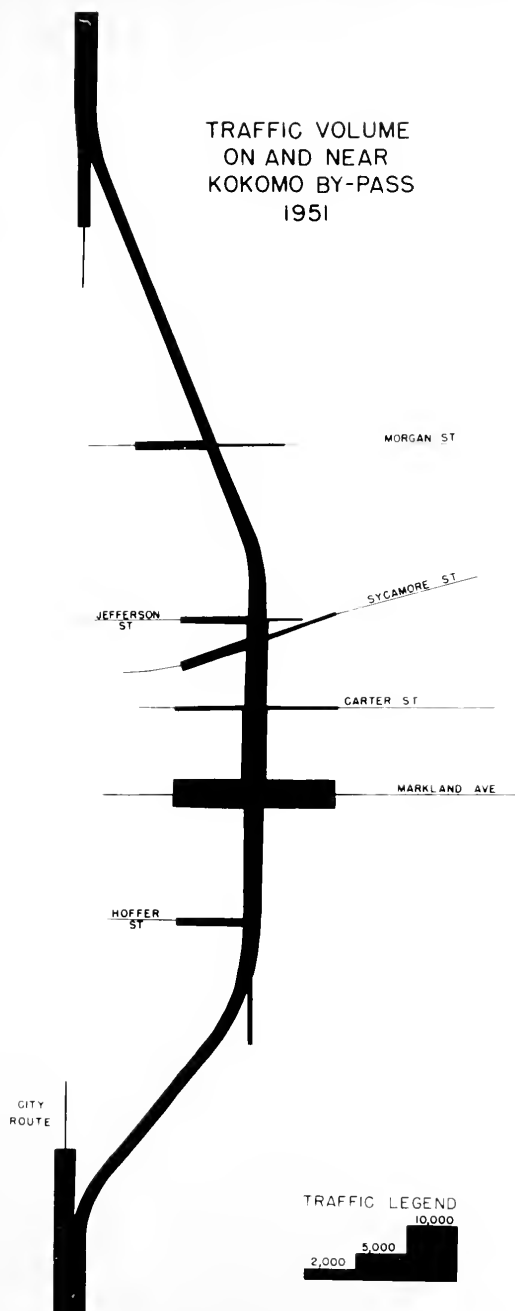


FIG. 10



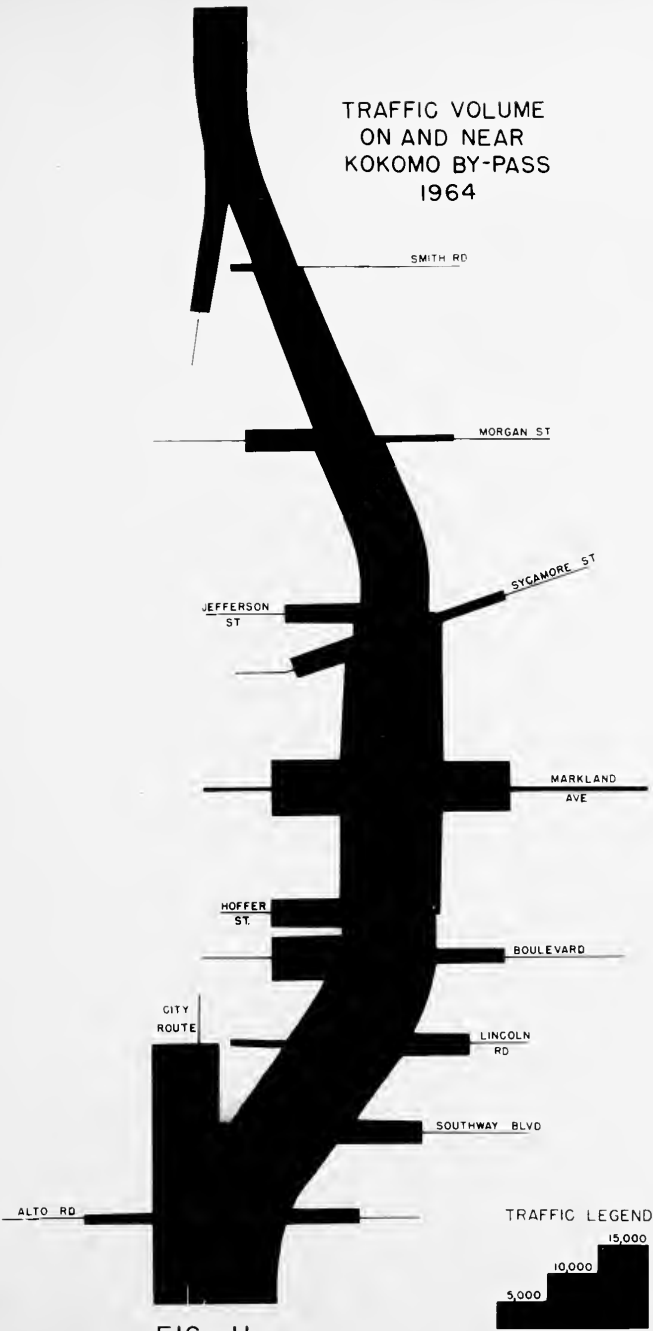


FIG. 11



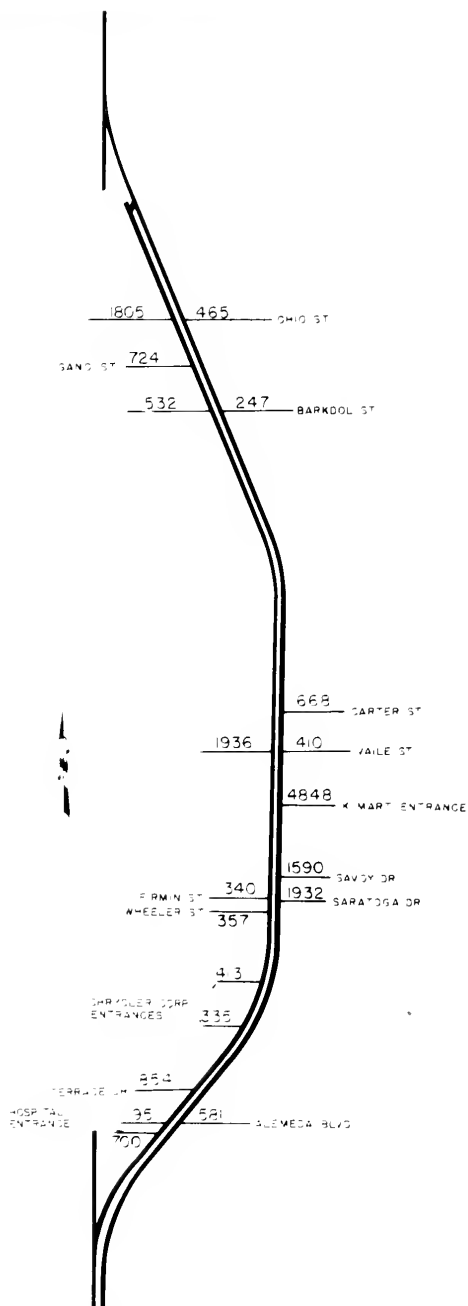


FIGURE 12 - TRAFFIC VOLUMES ON MINOR STREETS IN 1964



TABLE 4

TRAFFIC VOLUMES ON THE KOKOMO, INDIANA, BY-PASS

1951 to 1964

ON	LOCATION NEAR	FEB. 1951 AVG. WEEKDAY VOLUME	1964 AVG. WEEKDAY VOLUME
By-pass	East Blvd.	2500	17,700
By-pass	Markland	2900	18,200
By-pass	Jefferson	3300	14,300
By-pass	Smith Road	1700	8,600



TABLE 5

TRAFFIC VOLUMES ON STREETS INTERSECTING THE KOKOMO, INDIANA, BY-PASS

1951 to 1964

LOCATION ON NEAR	MAY 1951		NOV. 1957		1964	
	AVG. WEEKDAY VOLUME		AVG. WEEKDAY VOLUME		AVG. WEEKDAY VOLUME	
Jefferson	By-pass	1312		1427		3350
Sycamore	By-pass	1886		4524		4120
Hoffer	By-pass	1484		1941		4920
E. Blvd.	By-pass	N.A.		3132		7600
Markland	By-pass	6313		7104		9980



travel time, and an increase in accidents, all of which have reduced the operational efficiency of the by-pass. Because of increases in traffic volumes and a rapid growth of establishment adjacent to the by-pass, lower speed limits have necessarily been posted. With little imagination one can visualize the by-pass as becoming a major bottleneck for traffic in the near future.

With no access control provided, a route often loses some of its practical capacity, and this is indeed an undesirable characteristic of a noncontrolled access facility. On the other hand, fully controlled access facilities have proved to be able to retain their original practical capacity.

Past studies have also indicated that, contrary to the belief of some, controlled access facilities do not discourage development, but may actually accelerate the growth rate of desirable development (4). Business proprietors seem to be well aware of the fact that a controlled access facility will retain its high capacity, and many establishments adjacent to a new route are dependent upon high capacity.

The Kokomo street pattern in the north-south direction prior to opening the by-pass was substandard; however, the construction of the by-pass helped relieve this problem and enabled new areas to develop because of the accessibility provided by the new facility. Since the opening of the by-pass, the major growth in Kokomo has occurred in the area adjacent to the facility, and this undoubtedly can be attributed to the



presence and location of the route. Also, many traffic generators (commercial and industrial establishments) have developed adjacent to the by-pass. This development has been a major cause for the increasing traffic volumes from 1951 through 1964.

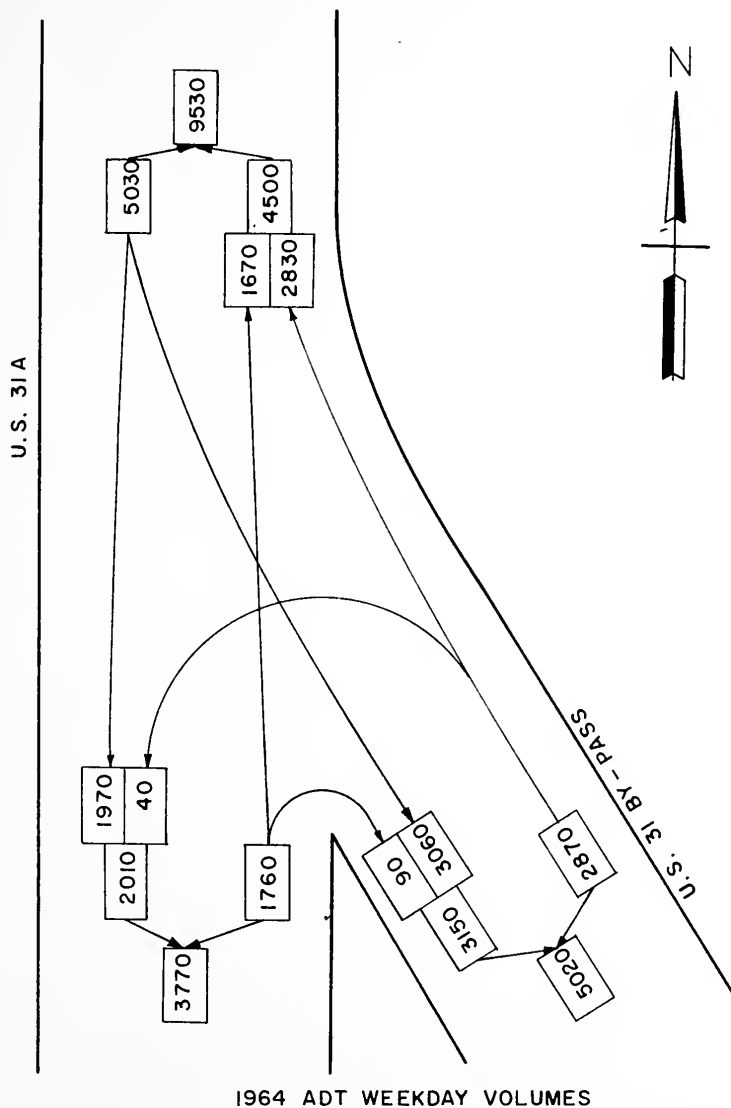
Another factor which is significant is that both local and through traffic utilize the by-pass. These incompatible uses are believed to be a primary contributor to vehicular accidents and delay on this highway (19).



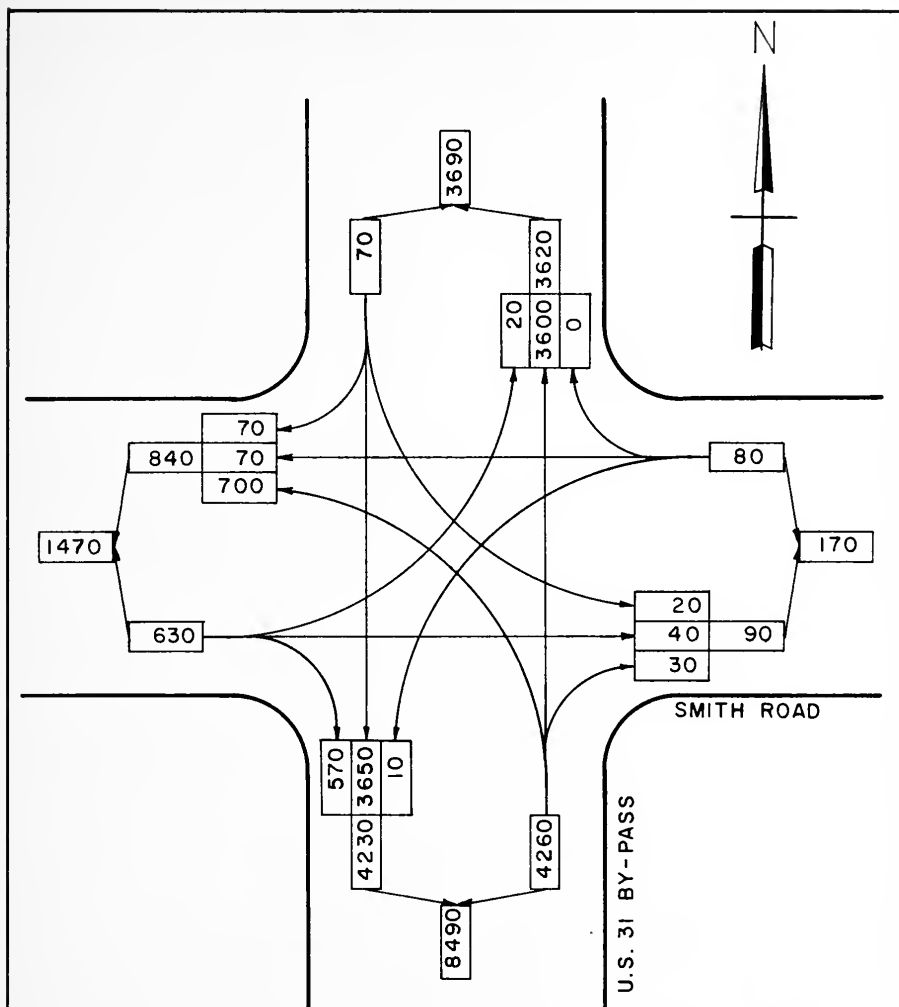
TURNING MOVEMENTS

Since a large volume of the traffic on the by-pass is local, a high percentage of turning movements exists at the intersection of primary streets and the by-pass. Turning movements are shown for the intersections of Alto, Southway, Lincoln, Boulevard, Hoffer, Markland, Sycamore, Jefferson, Morgan and Smith Streets with the by-pass as well as at both ends of the by-pass in Figures 13 - 24. Field data for these counts separated turning movements of the automobiles and trucks, but the two were combined for presentation in the report.

Turning movements are heaviest at Markland, East Boulevard, Sycamore, Hoffer, and Morgan with the predominant movement occurring between the by-pass and Kokomo. Markland and Smith Road have the highest percentages of truck turning movements. Most of the truck movements on Smith Road occur with trucks entering from the west and turning south on the by-pass or vice-versa. This indicates that many trucks leave U.S. 35 and travel on Smith Road and the by-pass to avoid traveling on U.S. 35 through the downtown portion of Kokomo. This indicates that it might be desirable to provide an improved route from U.S. 35 to the U.S. 31 By-pass north of the Kokomo city limits. This would provide an alternate for the through traffic on U.S. 35 and would help relieve

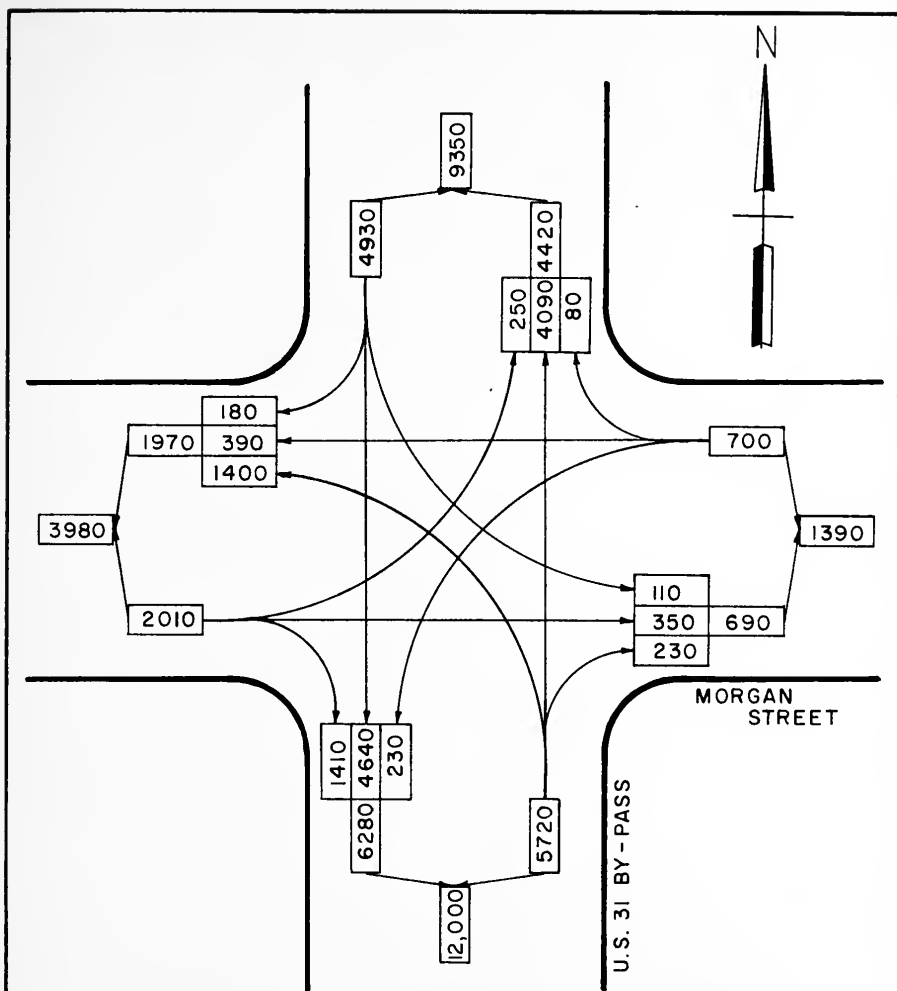


**FIG.13 - VOLUME AND TURNING MOVEMENTS
AT THE NORTH JUNCTION OF U.S. 31A
AND U.S. 31 BY-PASS**



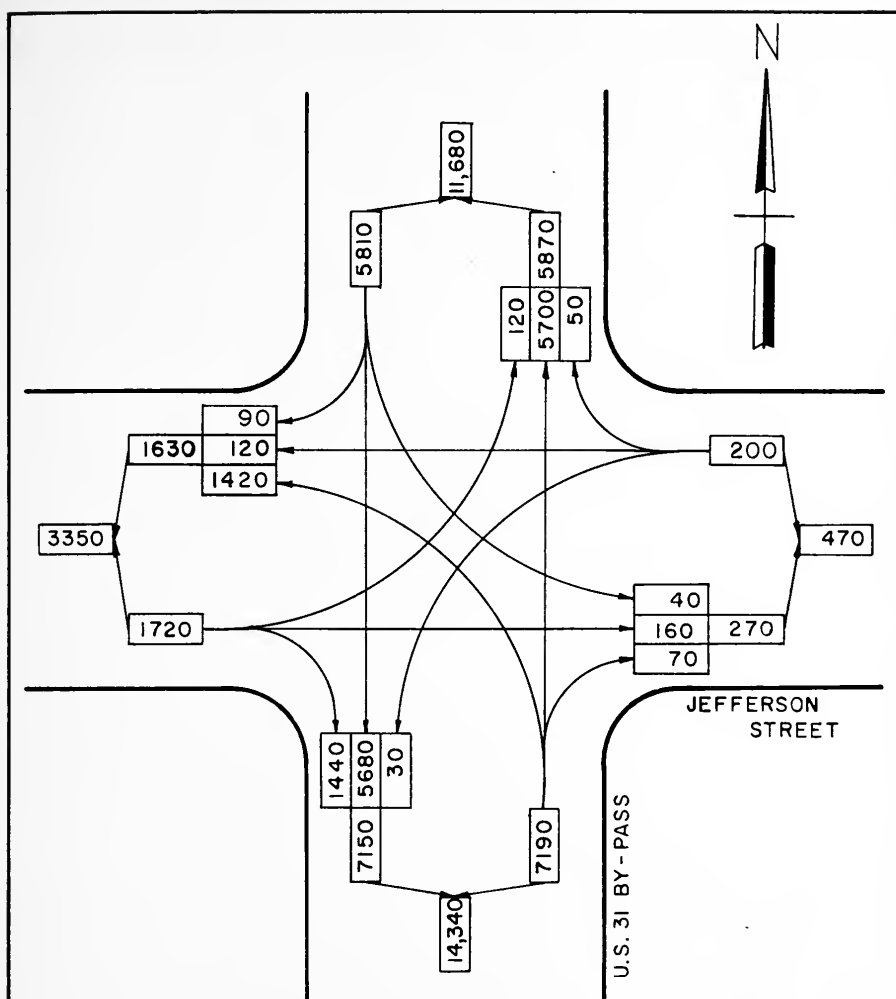
1964 ADT WEEKDAY VOLUMES

FIG.14 - VOLUME AND TURNING MOVEMENTS
AT SMITH ROAD AND U.S. 31 BY-PASS



1964 ADT WEEKDAY VOLUMES

FIG.15 - VOLUME AND TURNING MOVEMENTS
AT MORGAN STREET AND U.S. 31 BY-PASS



1964 ADT WEEKDAY VOLUMES

**FIG.16 - VOLUME AND TURNING MOVEMENTS
AT JEFFERSON ST. AND U.S. 31 BY-PASS**

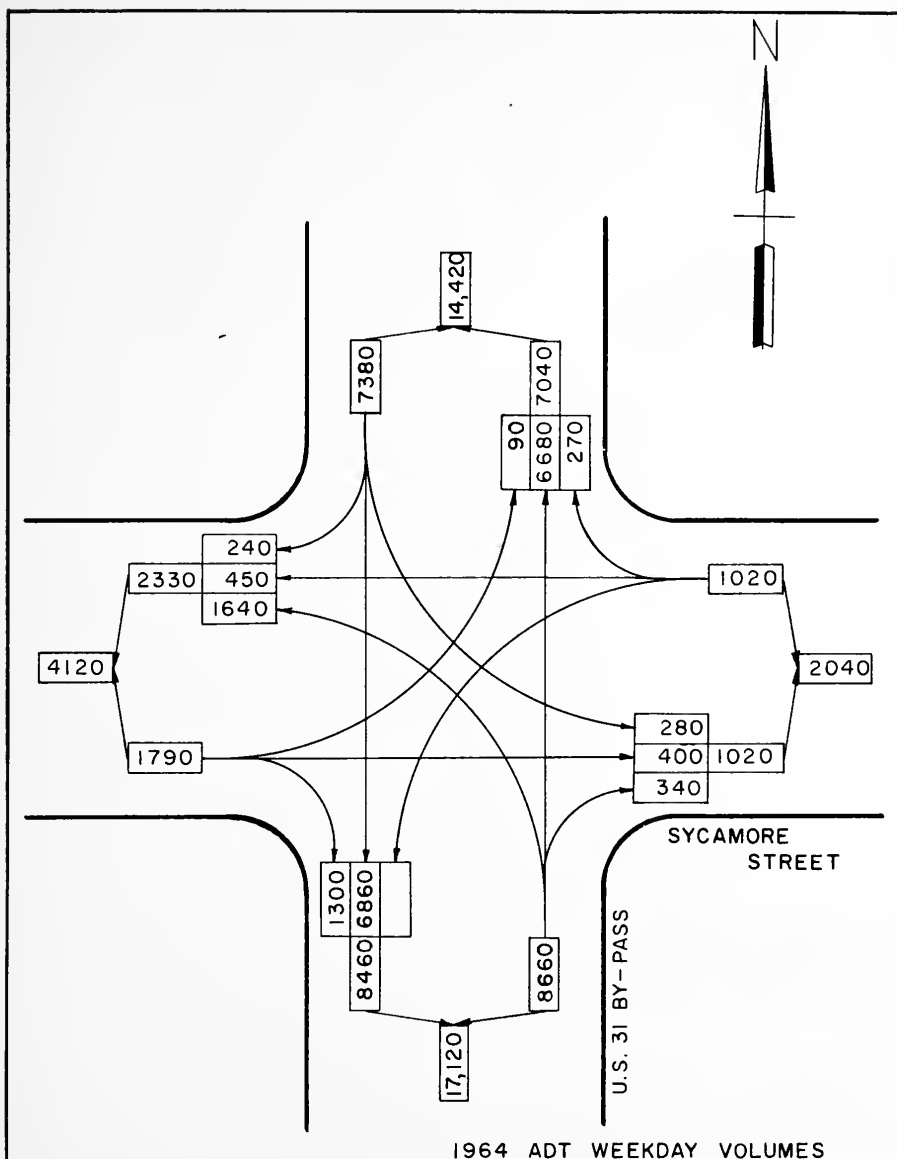


FIG.17 - VOLUME AND TURNING MOVEMENTS AT SYCAMORE STREET AND U.S.31 BY-PASS

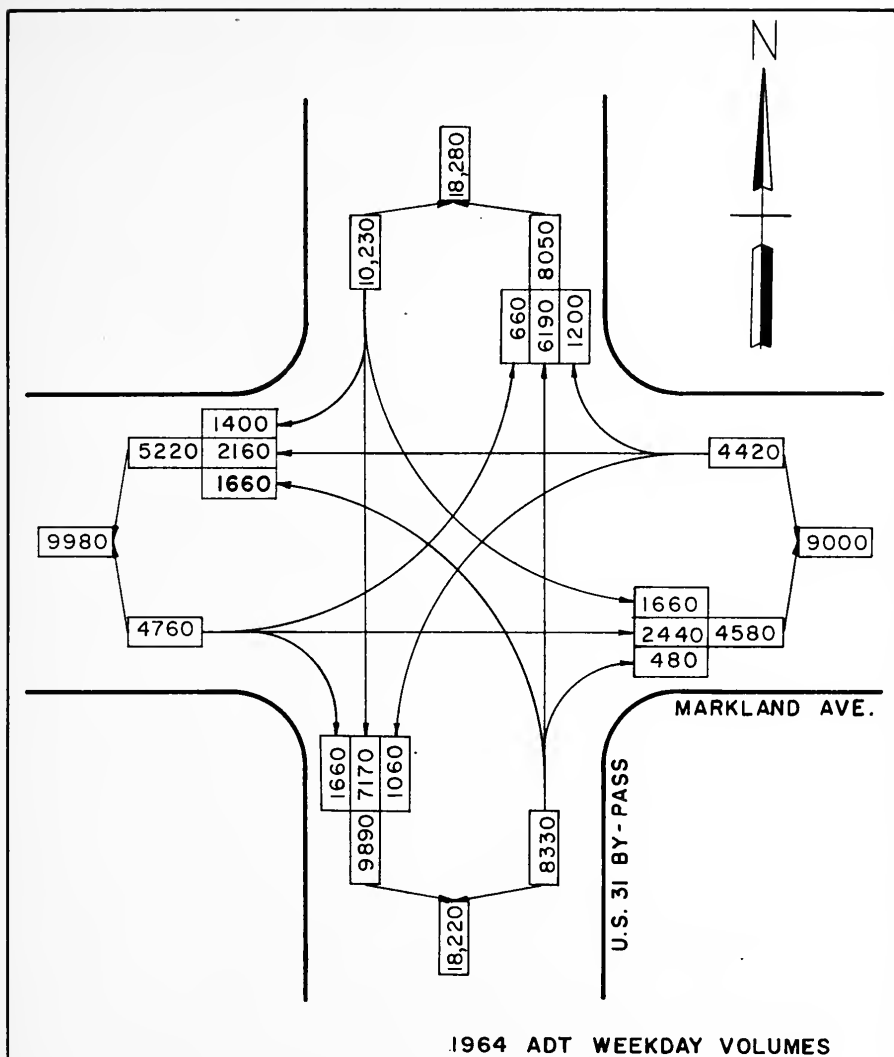
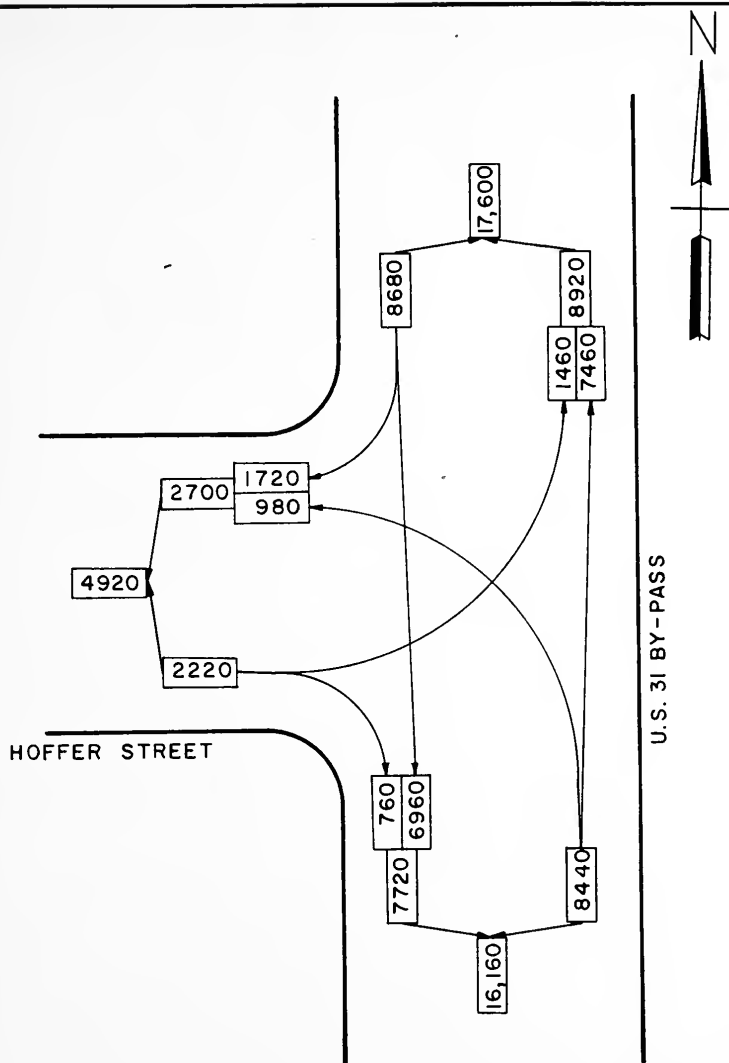
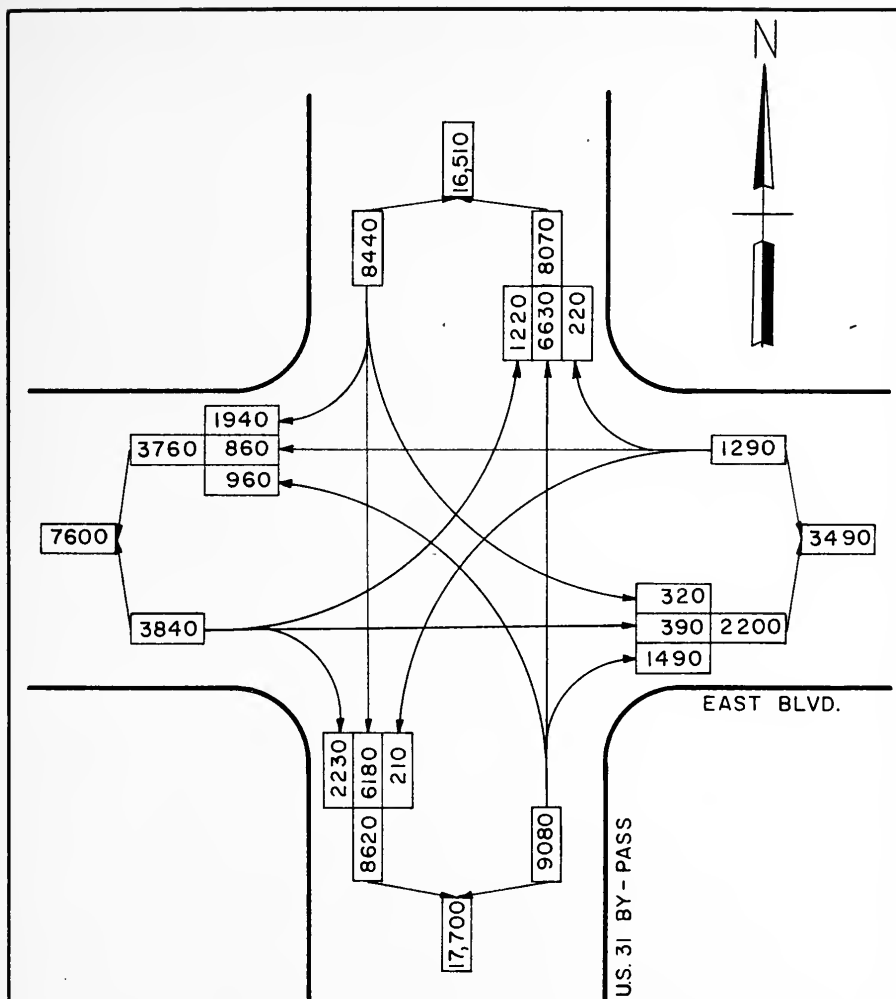


FIG.18 - VOLUME AND TURNING MOVEMENTS
AT MARKLAND AVE. AND U.S. 31 BY-PASS



1964 ADT WEEKDAY VOLUMES

**FIG.19 - VOLUME AND TURNING MOVEMENTS
AT HOFFER STREET AND U.S. 31 BY-PASS**



1964 ADT WEEKDAY VOLUMES

**FIG.20- VOLUME AND TURNING MOVEMENTS
AT EAST BLVD. AND U.S. 31 BY-PASS**

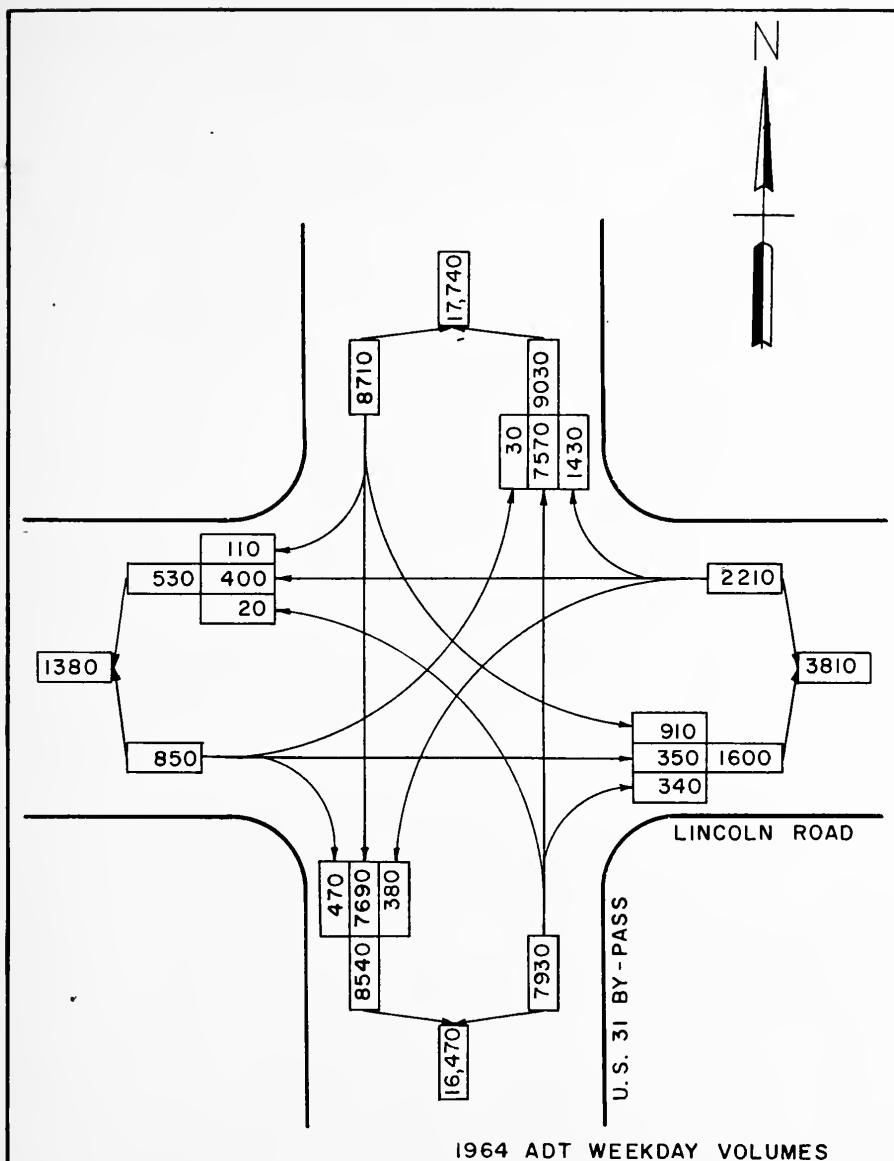
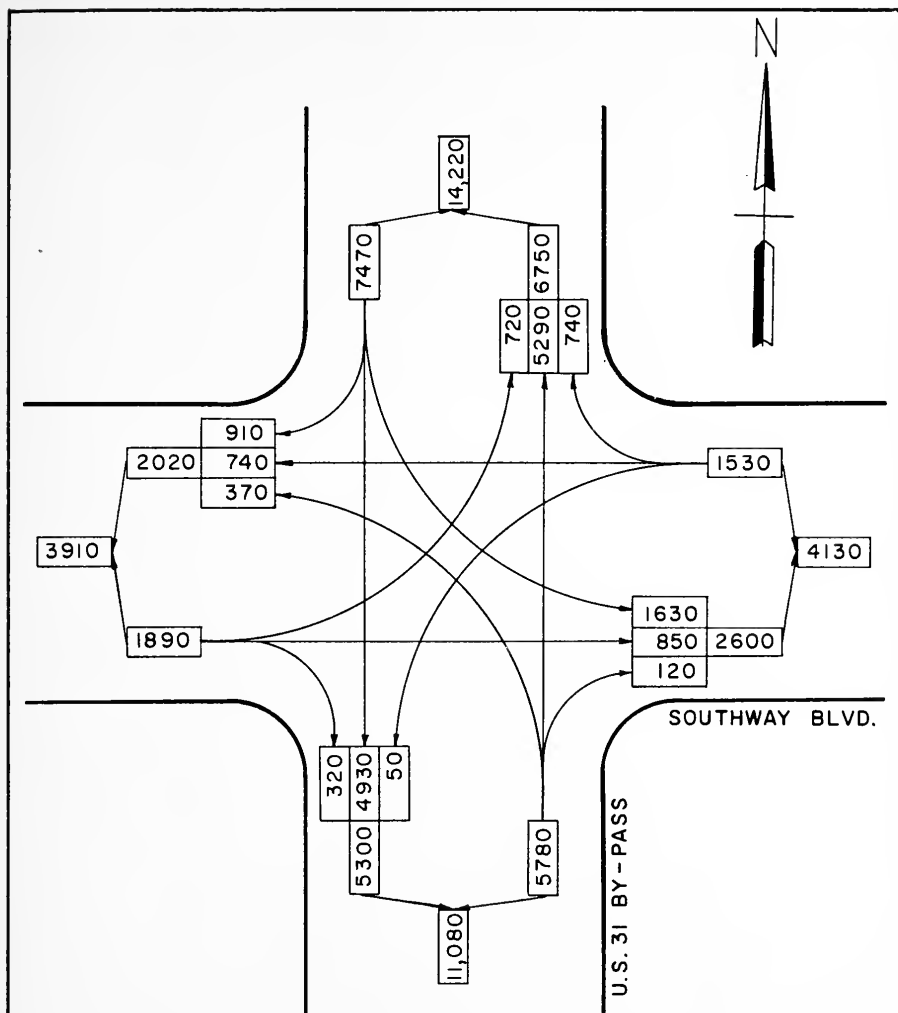
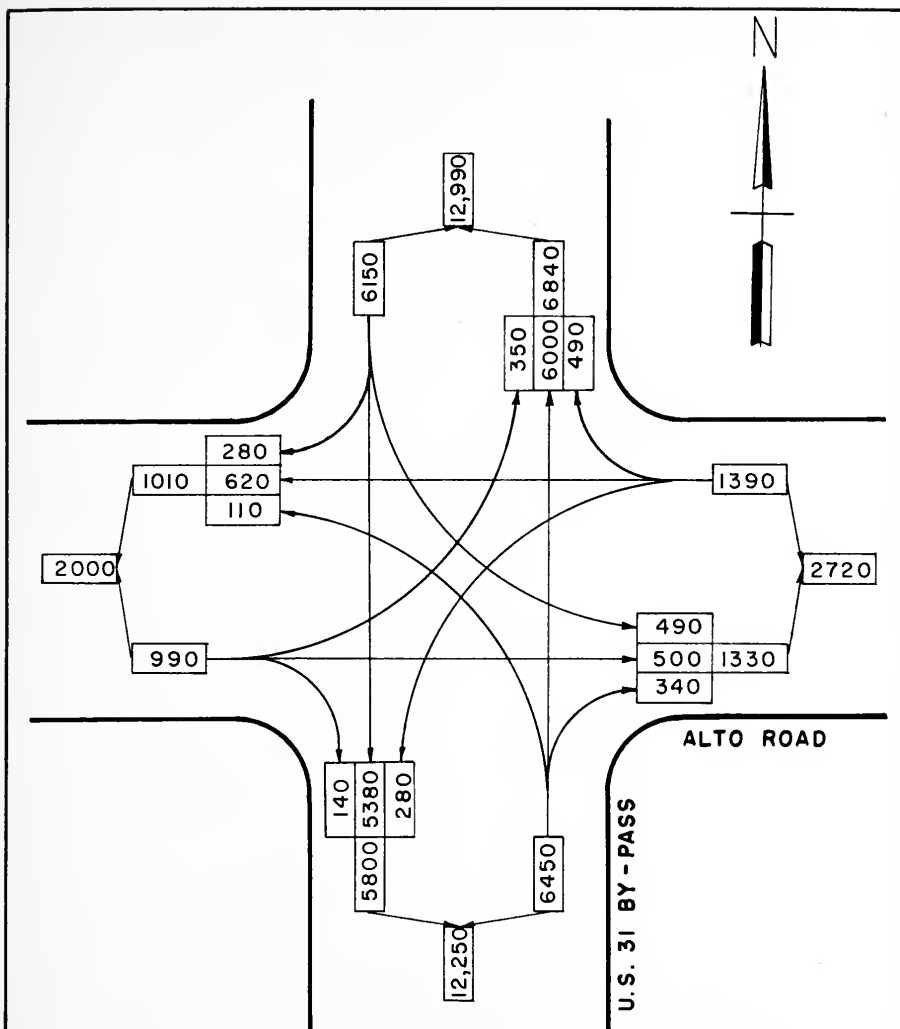


FIG.21 - VOLUME AND TURNING MOVEMENTS AT LINCOLN ROAD AND U.S. 31 BY-PASS



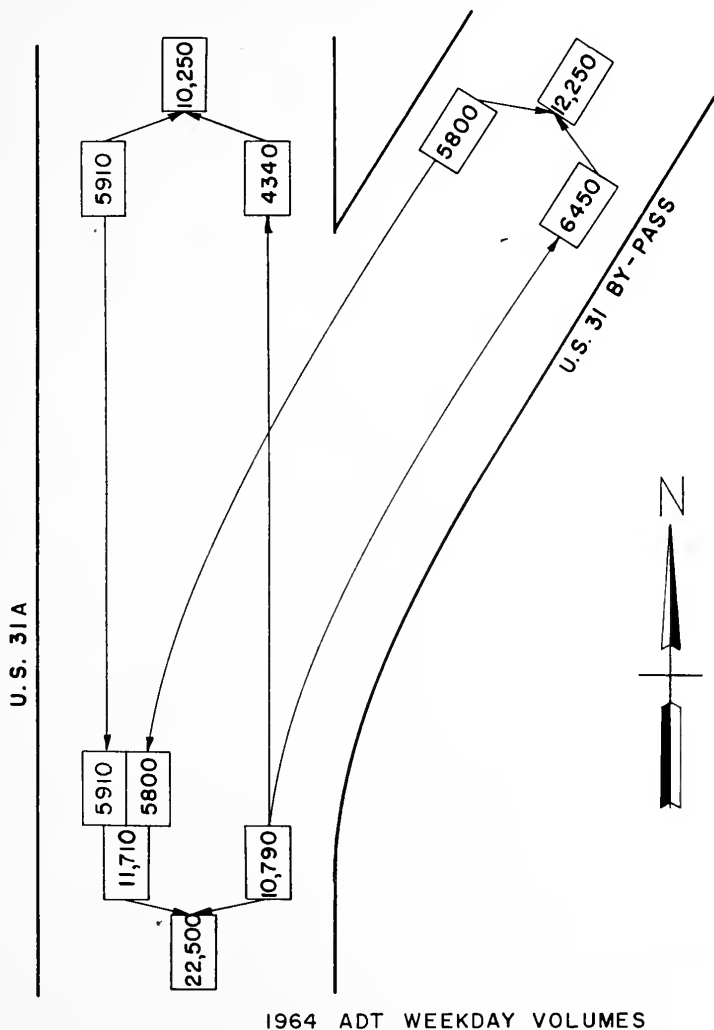
1964 ADT WEEKDAY VOLUMES

**FIG.22 - VOLUME AND TURNING MOVEMENTS
AT SOUTHWAY BLVD. AND U.S. 31 BY-PASS**



1964 ADT WEEKDAY VOLUMES

FIG.23 - VOLUME AND TURNING MOVEMENTS
AT ALTO ROAD AND U.S. 31 BY-PASS



**FIG.24- VOLUME AND TURNING MOVEMENTS
AT THE SOUTH JUNCTION OF U.S. 31A
AND U.S. 31 BY-PASS**

congestion problems in downtown Kokomo.

Semi-actuated traffic signals are present at the intersection of Lincoln, Boulevard, and Markland Streets. All intersections are at grade which results in a sizeable number of conflicting movements -- especially between southbound traffic on the by-pass and northbound vehicles on the by-pass making a left turn toward the city.

From the turning movement diagrams a traffic engineer can obtain information necessary for efficient operation of the intersection or possible redesign. Another equally important use of turning movements is to correlate them with the corresponding accident diagrams to seek methods for reducing the accidents.

When left turning movements are high, it is often desirable to add left turning lanes to provide shielded storage for vehicles waiting to make the left turn and, thus, reduce the number of potential rear-end accidents. Left turning lanes also minimize delay to the through motorist.

TRAVEL TIME

The primary purpose of a by-pass facility is to move traffic around a city in as short a time period as practical. When the driver is given a choice of alternate facilities, he usually selects the route which minimizes his travel time. For a by-pass to be justified the travel time required to traverse the by-pass must usually be less than the time required on the old route.

The "average car" method was used in collecting the travel time data for this study. This method is based on the assumption that the driver of the test car can judge the average speed of the moving stream. The driver passes approximately the same number of vehicles as pass him and travels at a speed which in the driver's opinion is the average speed of traffic at that particular time. Travel time runs were made on peak and off-peak volume hours to obtain an approximate average travel time for daily conditions. Test runs, however, were restricted to the daylight hours.

The data for the travel time analysis were collected in the following manner. The length of highway, both the city route and the by-pass, was divided into control sections. A fifth wheel was used to measure the length of each section.

Identifiable control points divided the sections, and when the travel time test car passed these control points, times were recorded.

Knowing the length of each section and average time to traverse each section, an average speed for each section was calculated. Times required to traverse a section of highway were obtained by using two stop watches. One watch ran continuously from one end of the by-pass to the other from which the overall speed could be calculated. The second stop watch recorded only the stopped time -- stoppages due to traffic signals, railroad crossings, and congestion. By knowing the stopped times, running speeds could be calculated.

Eight test runs were made in each direction on the city route of U.S. 31 and twenty-seven runs were made on the Kokomo By-pass. The results of these runs are presented in Figures 25, 26, 27, and 28. Figures 25 and 26 represent overall and running speeds for the sections on the city route while Figures 27 and 28 show overall and running speeds for the by-pass facility. Travel times for the calculations of running speeds were obtained by subtracting the stopped time from the times recorded from the continuously running watch for each section of highway. From Figures 25 and 26 it is seen that the greatest delay was encountered between West Boulevard and Morgan Street. This is the portion of the city route which contains traffic signals, railroad crossings, dense development, and congestion during peak volume periods -- all of which increase travel time and reduce speeds.

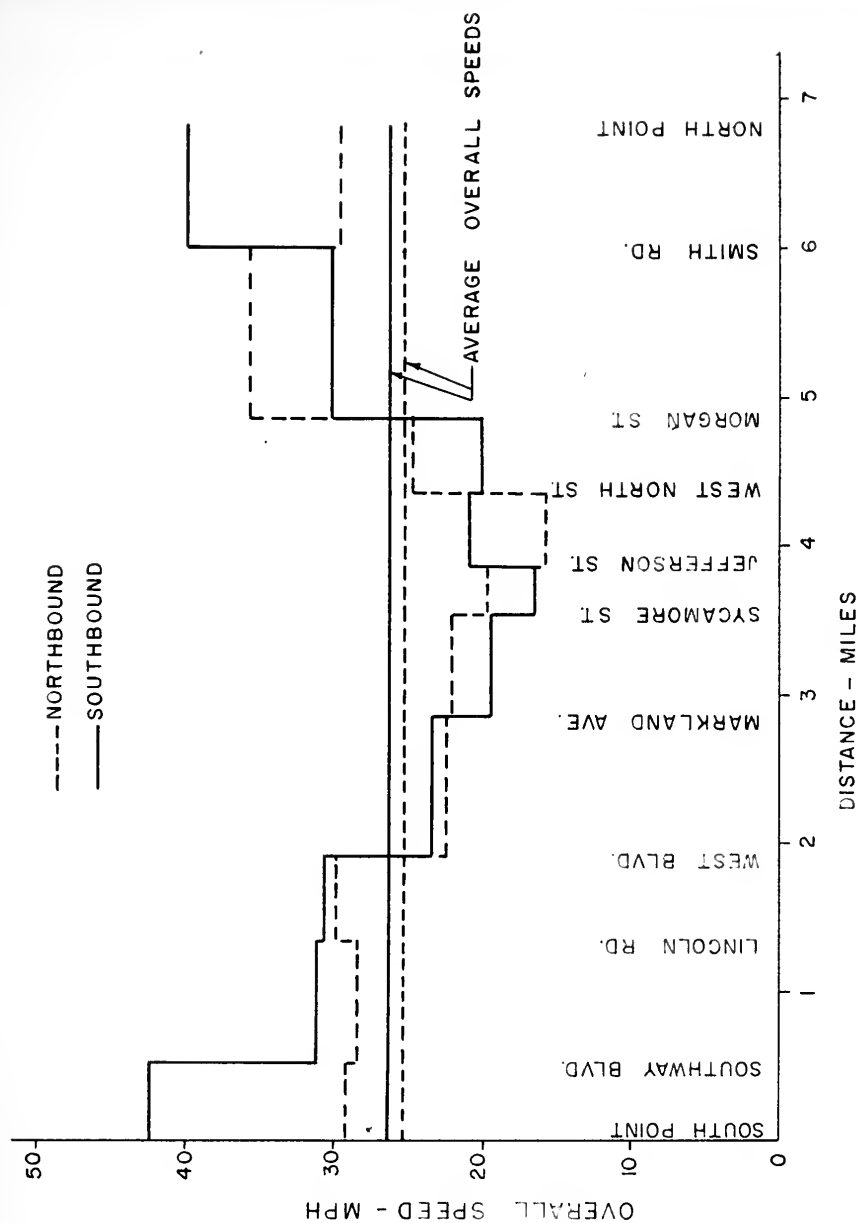


FIG. 25 - SPEED-DELAY FOR KOKOMO CITY ROUTE

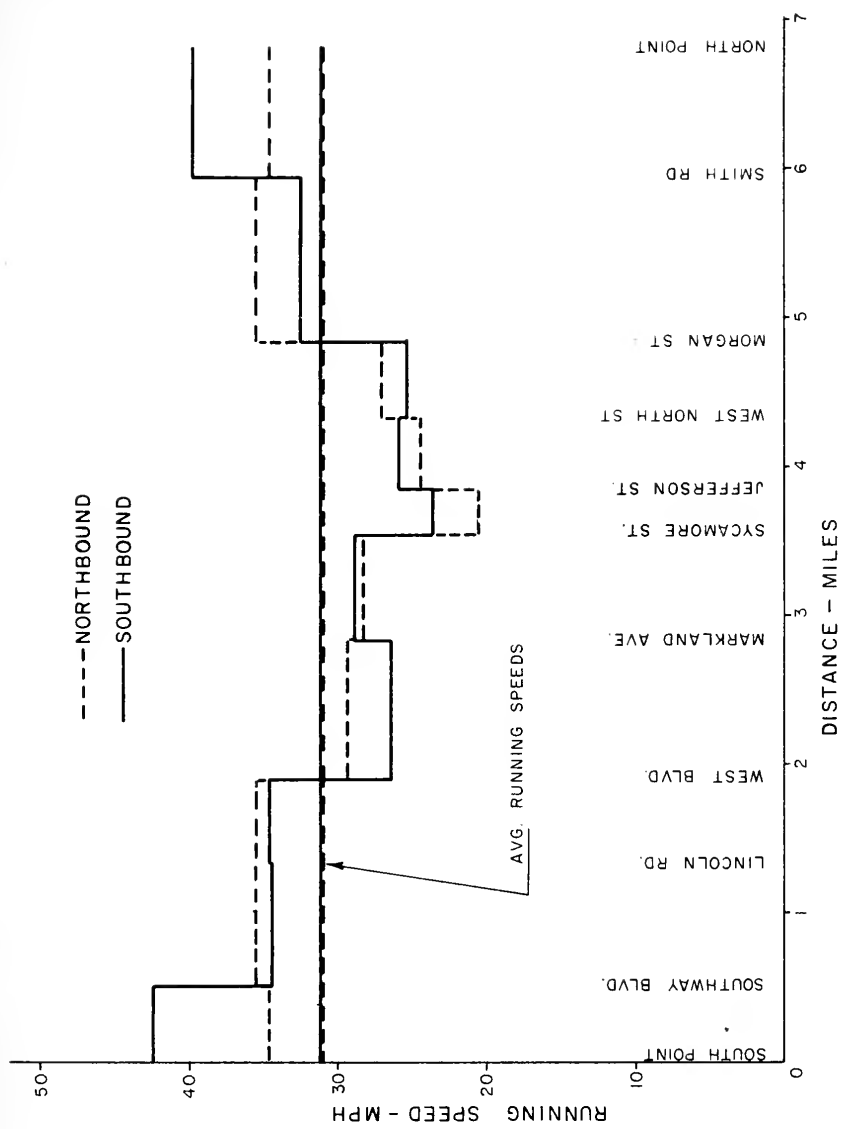


FIG.26 - SPEED-DELAY FOR KOKOMO CITY ROUTE

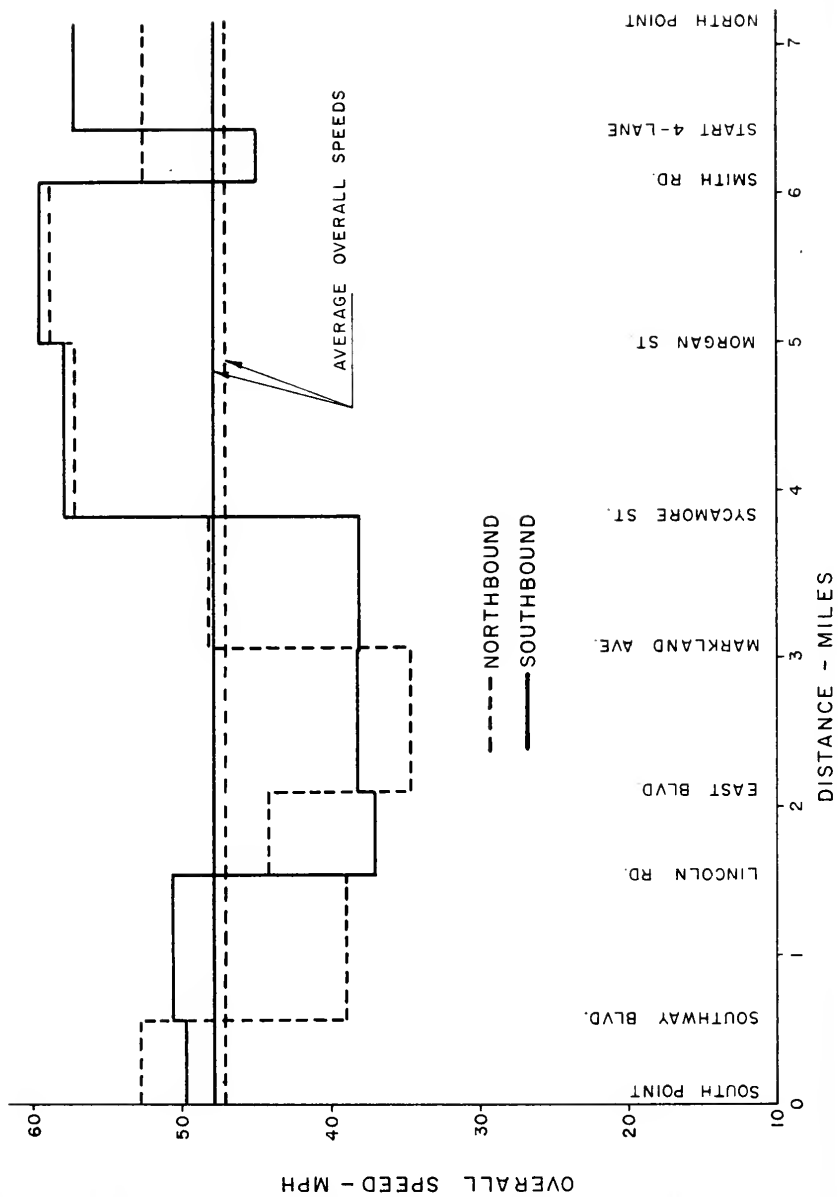


FIG. 27 - SPEED-DELAY FOR KOKOMO BY-PASS

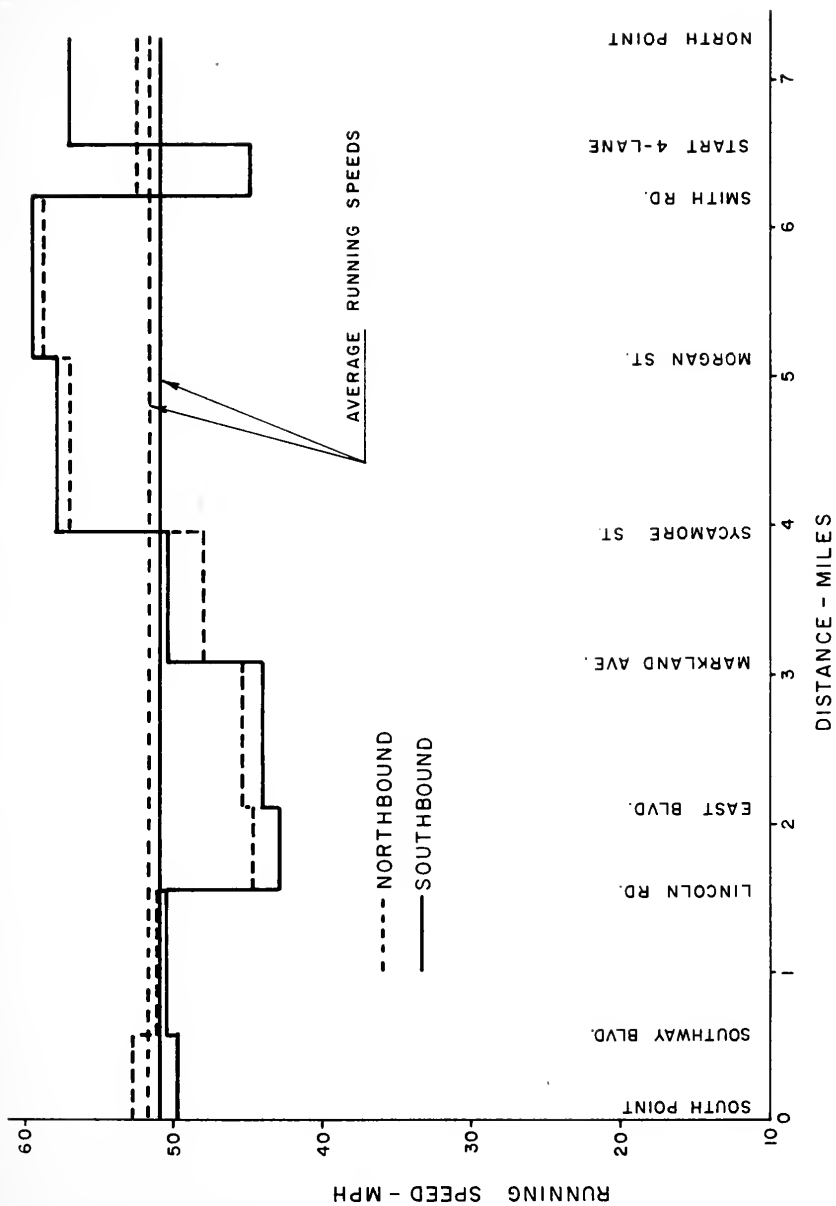


FIG. 28 - SPEED-DELAY FOR KOKOMO BY-PASS

Travel speeds on the by-pass were lowest between Southway Boulevard and Sycamore Street because of the presence of signals at Lincoln Road, East Boulevard, and Markland Avenue. The delay caused by the two railroad crossings in this section of the by-pass was negligible when compared to the delay caused by the traffic signals.

The overall average speed for both northbound and southbound traffic on the by-pass was 47.4 miles per hour while the overall speed on the city route was 25.7 miles per hour. Since the by-pass and the city route are 7.25 and 6.84 miles in length, respectively, a savings of 6 minutes and 45 seconds is realized when the motorist chooses to travel via the by-pass. The results show a time benefit ratio of 1.74 for the through driver who travels on the by-pass.

Figure 29 shows the increase in travel time required to traverse the by-pass for the period 1951 through 1964. The time required to traverse the by-pass has increased only 5 seconds from 1957 to 1964. This small increase was possible because of the construction of an additional two lanes in 1960 to provide a four-lane divided facility. Recently the Division of Traffic Engineering of the Indiana State Highway Commission conducted a study to determine if additional intersections on the by-pass possessed warrants for the erection of traffic signals. Should more signals be warranted and installed, an even greater travel time will be required to traverse the by-pass.

U.S. 31 BY-PASS 1951
TWO-LANES

OVERALL TIME: 8 MIN. 43 SEC.

RUNNING TIME: 8 MIN. 38 SEC.



STOPPED TIME: 5 SEC.

U.S. 31 BY-PASS 1957
TWO-LANES

OVERALL TIME: 9 MIN. 05 SEC.

RUNNING TIME: 8 MIN. 46 SEC.

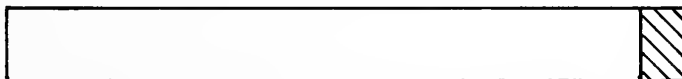


STOPPED TIME: 19 SEC.

U.S. 31 BY-PASS 1964
FOUR-LANES

OVERALL TIME: 9 MIN. 10 SEC.

RUNNING TIME: 8 MIN. 28 SEC.



STOPPED TIME: 42 SEC.

FIG. 29- BY-PASS TRAVEL TIME COMPARISONS

It is not difficult to visualize the by-pass becoming a congested urban arterial as further development occurs adjacent to the facility. The new developments will, in turn, generate more vehicular trips which will increase the traffic volume so that more intersections will warrant signals. The initial benefit of low travel times for the through motorist will be partially, if not completely, obliterated because of future traffic signals and lower speed limits and also because of general congestion that will necessarily develop. These undesirable events would not be possible had the by-pass been constructed as a fully controlled access facility with grade separations.

A similar comparison of the travel times on the U.S. 31 route through Kokomo is shown in Figure 30. Overall travel time has increased on this route as stopped time has increased.

For an economic analysis the present Kokomo By-pass with little access control was compared to a fictitious Kokomo By-pass with fully controlled access and grade separations. In the summer of 1964 the average speed in Indiana of free flowing passenger cars on four-lane divided facilities with controlled access and grade separations was found to be 62.7 miles per hour (5). Assuming that vehicles traveling on the Kokomo By-pass would have traveled in the same volume and at this speed had the facility been of the freeway type, a net savings of approximately \$270,000 would have been realized by motorists in just one year, 1964. This figure is based

BEFORE BY-PASS
U.S. 31 THROUGH KOKOMO 1950

OVERALL TIME: 14 MIN. 3 SEC.

RUNNING TIME: 13 MIN. 8 SEC.

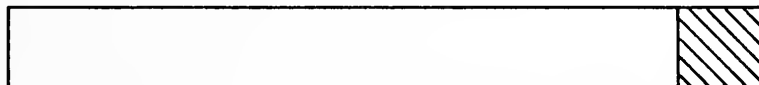


STOPPED TIME: 55 SEC.

AFTER BY-PASS
U.S. 31A THROUGH KOKOMO 1951

OVERALL TIME: 15 MIN. 9 SEC.

RUNNING TIME: 13 MIN. 37 SEC.



STOPPED TIME: 1 MIN. 32 SEC.

AFTER BY-PASS
U.S. 31A THROUGH KOKOMO 1964

OVERALL TIME: 15 MIN. 55 SEC.

RUNNING TIME: 13 MIN. 13 SEC.



STOPPED TIME: 2 MIN. 42 SEC.

FIG. 30 - CITY ROUTE TRAVEL TIME
COMPARISONS.

solely on time lost by the motorists traversing the by-pass and does not include such losses as stopping costs, operating costs, idling costs, starting costs, etc.

The \$270,000 in time savings was calculated as follows:

Travel time on present by-pass - 9.17 minutes

Travel time on freeway type by-pass - 6.94 minutes

Savings in time on freeway facility - 2.23 minutes

Vehicle-miles driven on Kokomo - 31,122,880

By-pass in 1964

Vehicles on Kokomo By-Pass - $\frac{31,122,880}{7.25} = 4,724,124$
in 1964

Savings in travel time

for 1964 had a freeway - $\frac{4,724,124 \times 2.23}{60} = 175,580$ veh-hrs.

type facility been

constructed

Travel time cost was evaluated at \$1.55 per vehicle-hour

(1).

Saving to motorist in

1964 had the by-pass been - $175,580 \times \$1.55 = \$272,149$

a freeway type facility

The above calculations are included to demonstrate the tremendous time savings to the motorist for the year 1964 had the facility been of the freeway type.

ACCIDENTS

The accident analysis which was conducted on the Kokomo By-pass indicates that many accidents can be related to a probable cause. An attempt was made to define areas of high accident rates and to describe those factors which contributed to the accident rate. Although the analysis includes some accidents since 1953, accidents occurring in 1961, 1962, and 1963 were the primary data considered since these accidents occurred on the present four-lane divided facility.

An accident spot map for the Kokomo By-pass indicates that the majority of the accidents happen at intersections (see Figure 31). These accidents were classified into three types: property damage, personal injury, and fatality. This classification also describes the severity of the accident. Accidents were most prevalent along the Kokomo By-pass at the following intersections: Markland Avenue, Sycamore, East Boulevard, Alto Road, and Southway Boulevard. The accident involvement rate is also high at the crossover at the north end of the by-pass.

Figure 32 is a pictorial view of the accident involvement by hour of the day. The 6:00 to 7:00 AM and 3:00 to 4:00 PM accident percentages are of interest since during these two

ACCIDENTS

PROPERTY DAMAGE	-	204
PERSONAL INJURY	-	94
FATAL	-	1
		<hr/>
		299

ACCIDENT LEGEND

- PROPERTY DAMAGE
- PERSONAL INJURY
- ⊗ FATAL

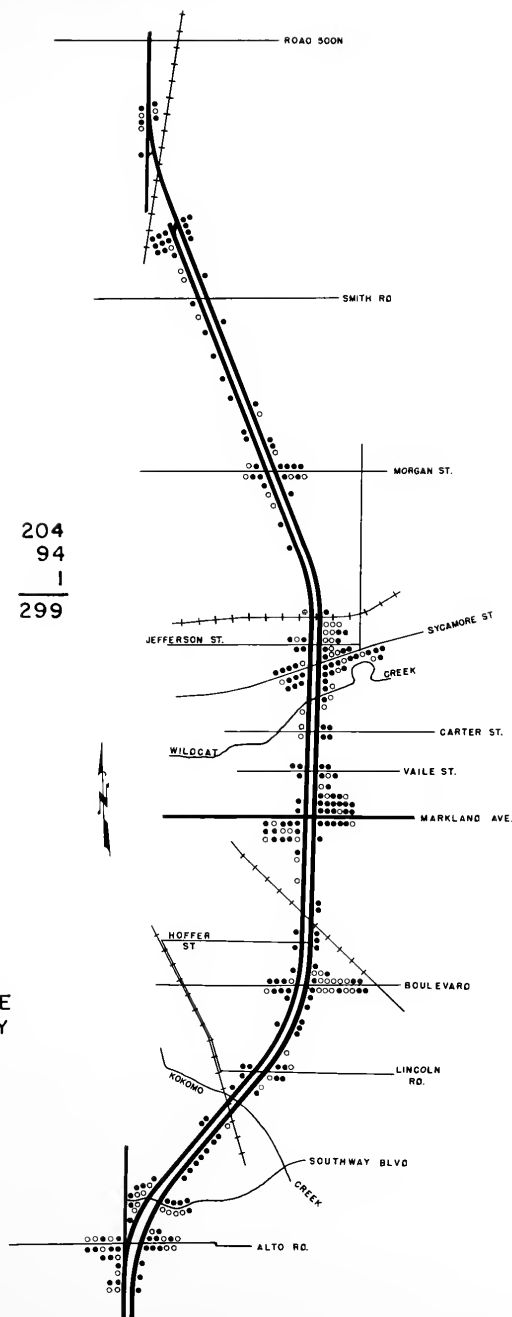


FIGURE 31 - ACCIDENT SPOT MAP FOR KOKOMO BY-PASS
FOR 1961, 1962 AND 1963

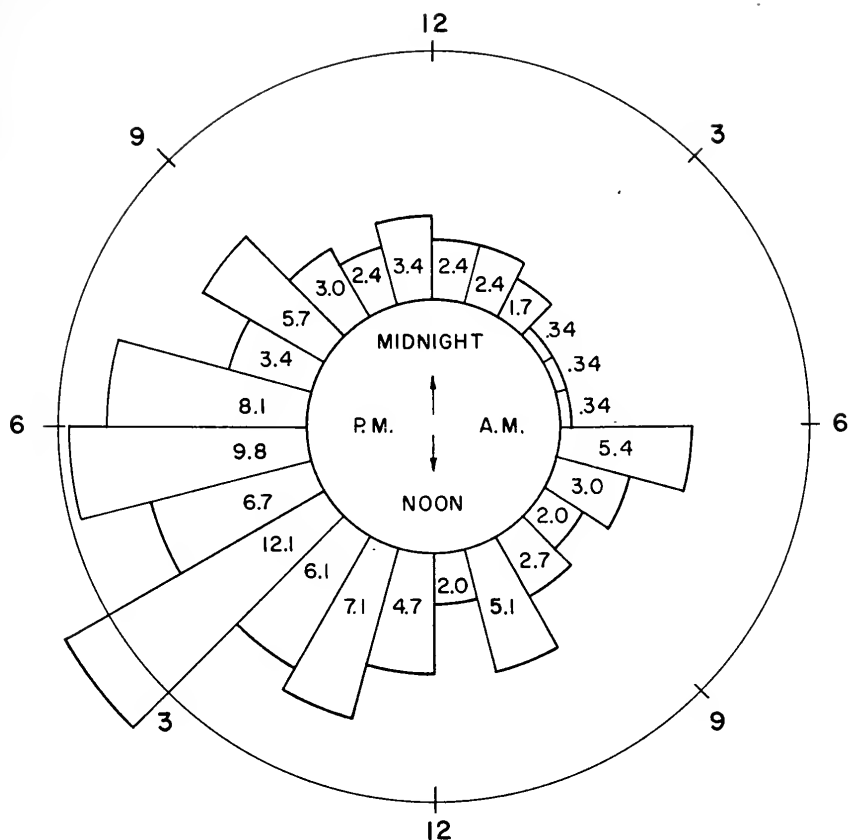


FIG. 32 - TRAFFIC ACCIDENT DISTRIBUTION ON THE
KOKOMO BY-PASS BY HOUR OF DAY FOR
1961, 1962, AND 1963 .

hours there is a change in working personnel at industries adjacent to the by-pass. The morning accident peak of 5.4 percent of the daily accidents is much lower than the 3:00 to 4:00 PM accident peak even though the traffic volume between 6:00 and 7:00 AM is almost as heavy as the 3:00 to 4:00 PM volumes.

The reason for the lower accident rate between 6:00 and 7:00 AM might be explained by the fact that in the morning workers are in a hurry to get to work, and their driving speeds approximate the speeds driven by the through motorist. Furthermore, during the early morning hours the shopper and other potentially slow drivers are not on the by-pass; therefore, drivers on the by-pass between 6:00 and 7:00 AM are traveling at a uniform speed which is indicative of safer operating conditions (19). During the 3:00 to 4:00 PM accident peak, however, many motorists are shopping or are making other short trips where their operating speeds are slow. Yet, even at this time of day, the through driver desires to travel at a high rate of speed, and it may be this variability in driving speeds which is conducive to high accident rates (19). It is also interesting to note that over 70 percent of the accidents occurred in the PM hours.

The accident occurrence on the Kokomo By-pass by day of week is typical to the curve found for most urban sections of highway (see Figure 33). The percentage of weekly accidents is highest on Friday and Saturday. Traffic volumes, which

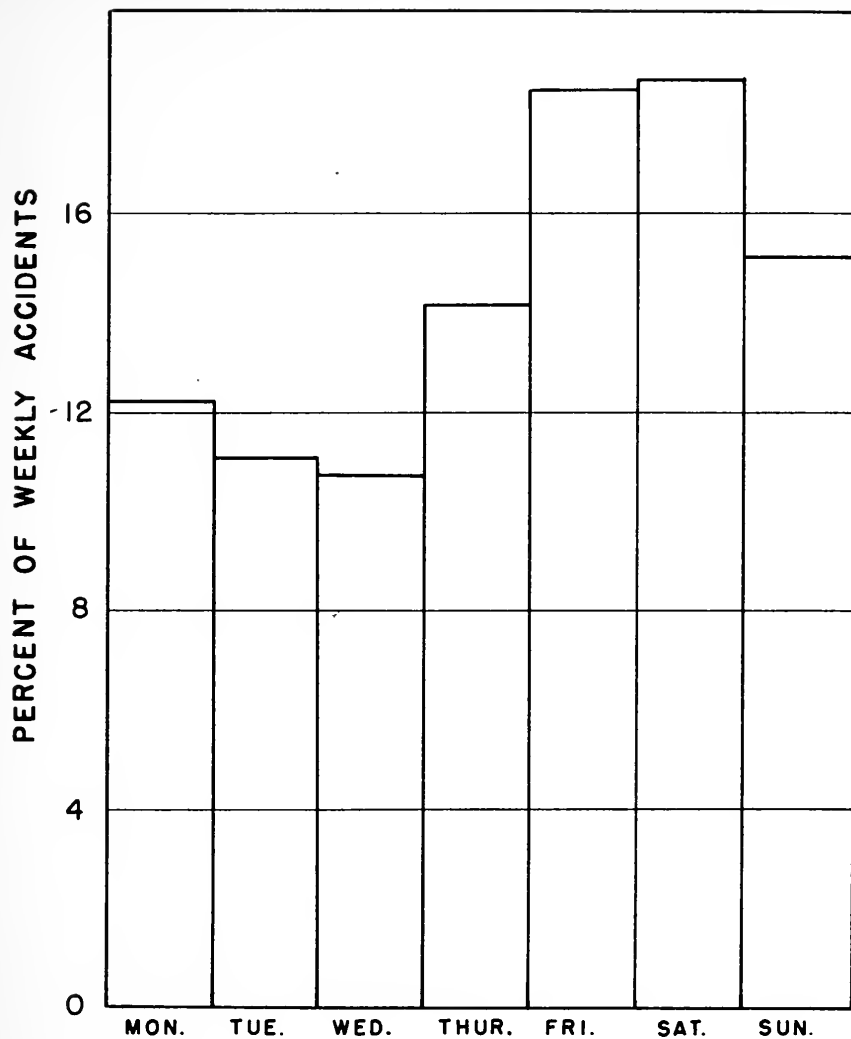


FIG. 33-TRAFFIC ACCIDENT DISTRIBUTION ON
THE KOKOMO BY-PASS BY DAY OF
WEEK FOR 1961, 1962, AND 1963.

are also heaviest on Friday's and Saturday's, appear to generate a higher accident probability.

Autumn and winter months were the most conducive to traffic accidents (see Figure 34). Traffic volumes are lowest for the winter months, however. This means that the accident rate is highest during the autumn and winter. An investigation of the causes of high accident rates in the winter months revealed that many accidents were of the rear-end type at signalized intersections. Many of these accidents occurred under slippery pavement conditions.

A method for evaluating the degree of hazard at intersections has been developed by E. C. Williams (23). It has long been known that the number of accidents alone is not a good criteria for evaluating the relative hazard at various locations. The formula developed by Williams to measure the intersection hazard is as follows:

$$H_1 = A_t \times \frac{W_1}{V_1} \times \frac{W_2}{V_2} \times \dots \times \frac{W_n}{V_n}$$

Where

H_1 = Measure of intersection hazard

A_t = Total annual accidents for the intersection

n = Total number of approaches to the intersection

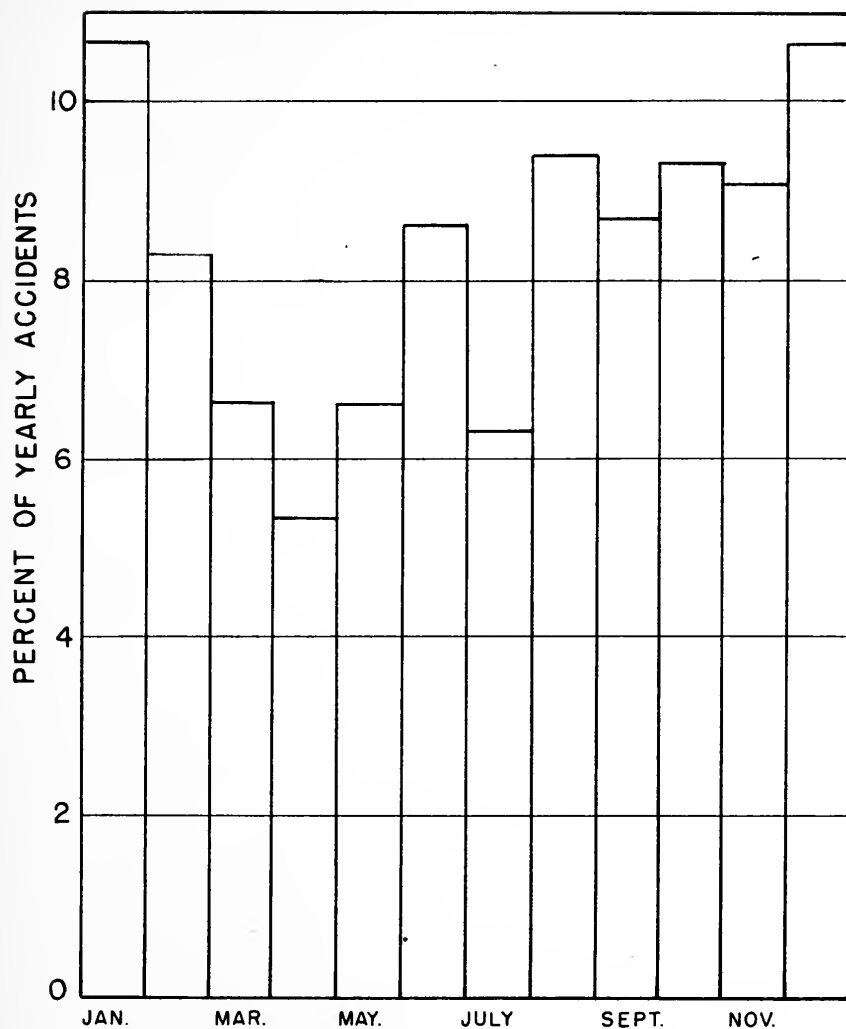


FIG. 34 - TRAFFIC ACCIDENT DISTRIBUTION ON THE
KOKOMO BY-PASS BY MONTH OF YEAR
FOR 1961, 1962, AND 1963.

W_1 = Pavement width available for traffic entering approach
"one" of the intersection

W_2 = Pavement width available for traffic entering approach
"two" of the intersection

W_n = Pavement width available for traffic entering approach
"n" of the intersection

V_1 = Volume (ADT) entering intersection on approach "one"

V_2 = Volume (ADT) entering intersection on approach "two"

V_n = Volume (ADT) entering intersection on approach "n"

For the purpose of this study the accidents and volumes for 1961, 1962, and 1963 were used since a three year period affords a more representative sample. Ten intersections were considered in this analysis, and the results are presented in Table 6. From this Table it is apparent that an accident spot map may not portray the true hazard. Had the intersections been rated for hazard on the basis of the number of accidents alone, Markland would have been classified as most hazardous. It was the sixth most hazardous when rated by Williams' hazard formula.

Results from the hazard formula show the Sycamore intersection to be the most hazardous while the Smith Road intersection with the by-pass is least hazardous. The rating of intersections by the hazard formula provides a basis for determining priority of intersection correction.

TABLE 6

INTERSECTION	ACCIDENTS A_t	MEASURE OF INTERSECTION HAZARD								HAZARD
		APPROACH WIDTHS (in feet)				ADT APPROACH VOLUMES (in 1000's)				
		w_1	w_2	w_3	w_4	V_1	V_2	V_3	V_4	
Sycamore	31	47	24	34	12	7.38	1.02	8.66	1.79	122,000
Jefferson	6	36	12	34	11	5.81	0.20	7.19	1.72	67,700
Southway	16	45	21	43	21	1.53	5.78	7.47	3.91	52,800
Alto	20	24	24	22	11	6.45	1.39	6.15	0.99	51,200
Morgan	9	47	11	34	11	5.72	0.70	4.93	1.97	44,700
Markland	36	48	24	45	22	8.33	4.42	10.23	4.76	22,900
E. Boulevard	25	36	21	34	10	8.44	1.29	9.08	3.84	16,900
Lincoln	4	36	12	34	22	8.71	2.21	7.93	0.85	11,300
Hoffer	1	36	20	34	--	8.68	7.72	2.22	----	165
Smith	0	24	9	22	10	4.26	0.63	3.74	0.80	0

Another point of interest is the low degree of hazard at the intersection of Hoffer Street and the by-pass. This intersection has only three approach legs, all of which carry high volumes. Based on this intersection it appears that, where possible, the T-type intersection is desirable from a safety point of view.

Quality control analysis was another technique utilized to locate high accident locations along the by-pass facility (17). For this analysis the by-pass was divided into six sections, and these sections are shown in Figure 35. This method was used to isolate sections which were out of control because of measurable environmental factors. The basic control limits were developed as follows:

$$UCL = \lambda + t \sqrt{\frac{\lambda}{m}} + \frac{0.829}{m} + \frac{1}{2m}$$

$$LCL = \lambda - t \sqrt{\frac{\lambda}{m}} + \frac{0.829}{m} - \frac{1}{2m}$$

where

UCL = Upper control limit

LCL = Lower control limit

λ = Probability of an accident in a car-mile for the three year period 1961, 1962, 1963.

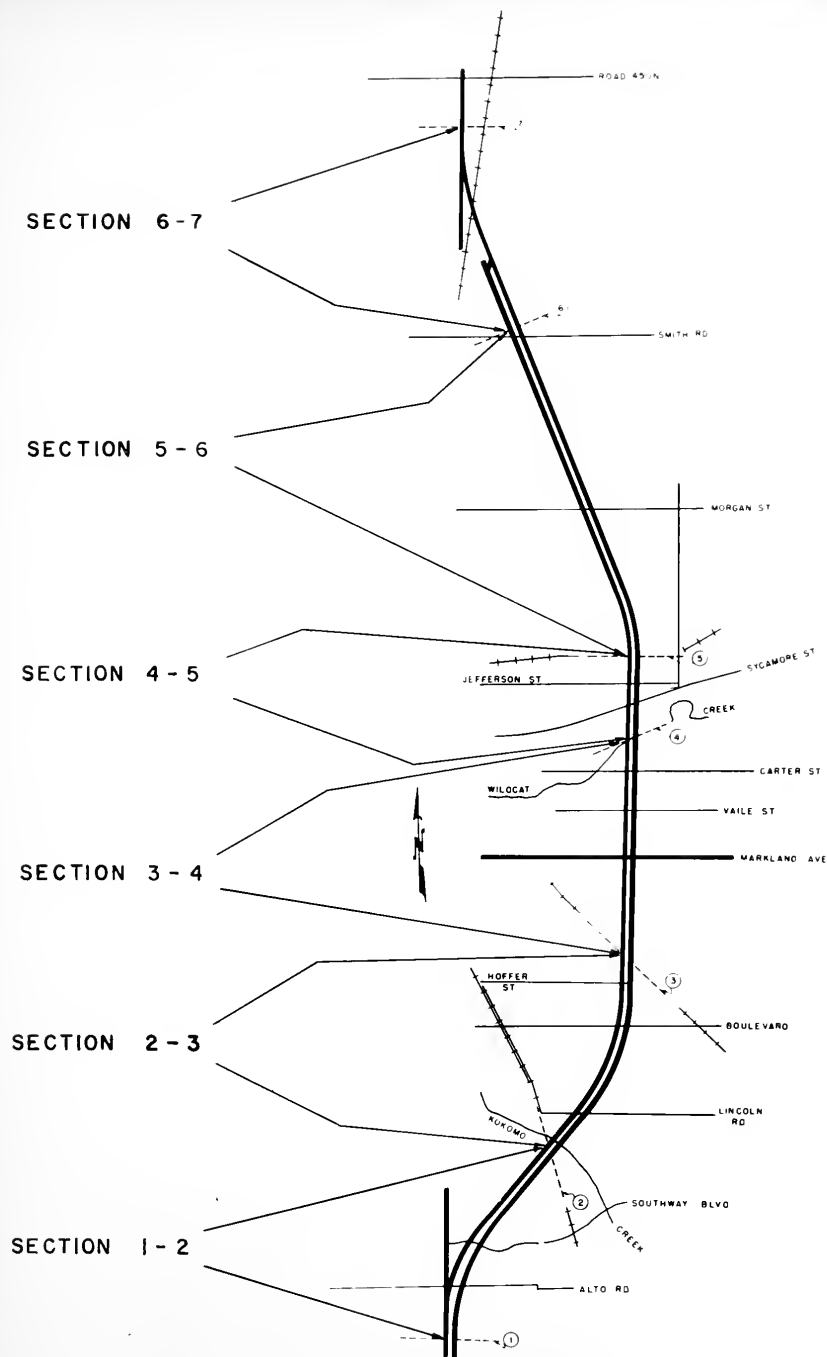


FIGURE 35 - SECTIONS OF THE KOKOMO BY-PASS FOR THE QUALITY CONTROL ANALYSIS

m = Vehicle miles of travel on a section for 1961, 1962, and 1963.

t = Student's t-statistic

The level of confidence used for this analysis was 0.99. The two factors which vary the control band widths from section to section are the number of vehicles per section (volume) and the length of the section. Since it was surmised that the northbound and southbound lanes had different involvement characteristics, an accident rate was computed for each direction. The northbound accident rate for the entire length of the by-pass was 3.5×10^{-6} while the southbound accident rate was 2.7×10^{-6} .

From the northbound quality control chart (see Figure 36) it is seen that two of the sections were out of control. Section 4-5 was out of control on the high side while the accident rate in section 5-6 was below the lower control limit. It is of interest to note that section 4-5 contains the intersections of Sycamore and Jefferson Streets with the by-pass. These two intersections were ranked as most hazardous and second most hazardous, respectively, when analyzed by the hazard formula. Section 5-6 has a low accident rate because little access is provided to the by-pass in this section of the facility.

Several factors are believed to have contributed to the high accident involvement at Sycamore Street. When approaching the by-pass from the west, the by-pass is virtually

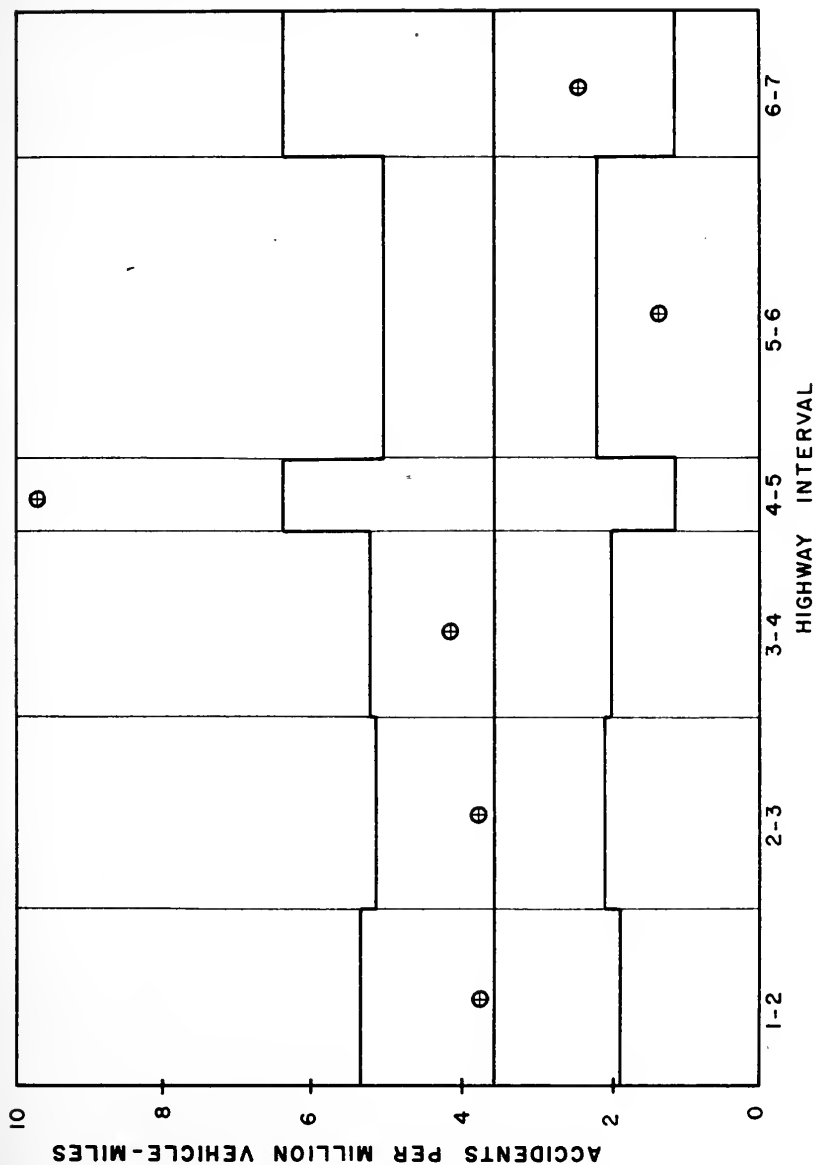


FIG. 36- CONTROL CHART OF SECTION ACCIDENT RATES FOR NORTHBOUND TRAFFIC DURING 1961, 1962, AND 1963

invisible until the driver is quite near the by-pass. Improvement of visibility at this intersection is certainly desirable, and until this can be accomplished, a warning flasher for eastbound traffic on Sycamore might be desirable. Also during 1961, 1962, and 1963 there were at least five right angle or left turning collisions per year. Another factor which might contribute to the high accident rate is that southbound traffic on the by-pass in the vicinity of Jefferson and Sycamore Streets is traveling at a high rate of speed, and there is the possibility that drivers trying to enter, cross, or leave the by-pass underestimate the speed of vehicles traveling on the by-pass. An attempt to slow the by-pass traffic appears warranted.

Figure 37 shows the southbound quality control chart. None of these sections were out of control, but accidents in sections 1-2 and 6-7 might be reduced by making some minor alterations in the physical features within these sections.

For section 1-2 the southbound traffic is channelized at approximately Alto Road to the inside lane to minimize the conflict between merging traffic at the south end of the by-pass. No left turning lane has been provided for the southbound by-pass traffic wishing to turn left at Alto Road. This means that both through and left turning traffic use the inside lane, and this has resulted in several rear-end collisions. A study of the accident records indicates that

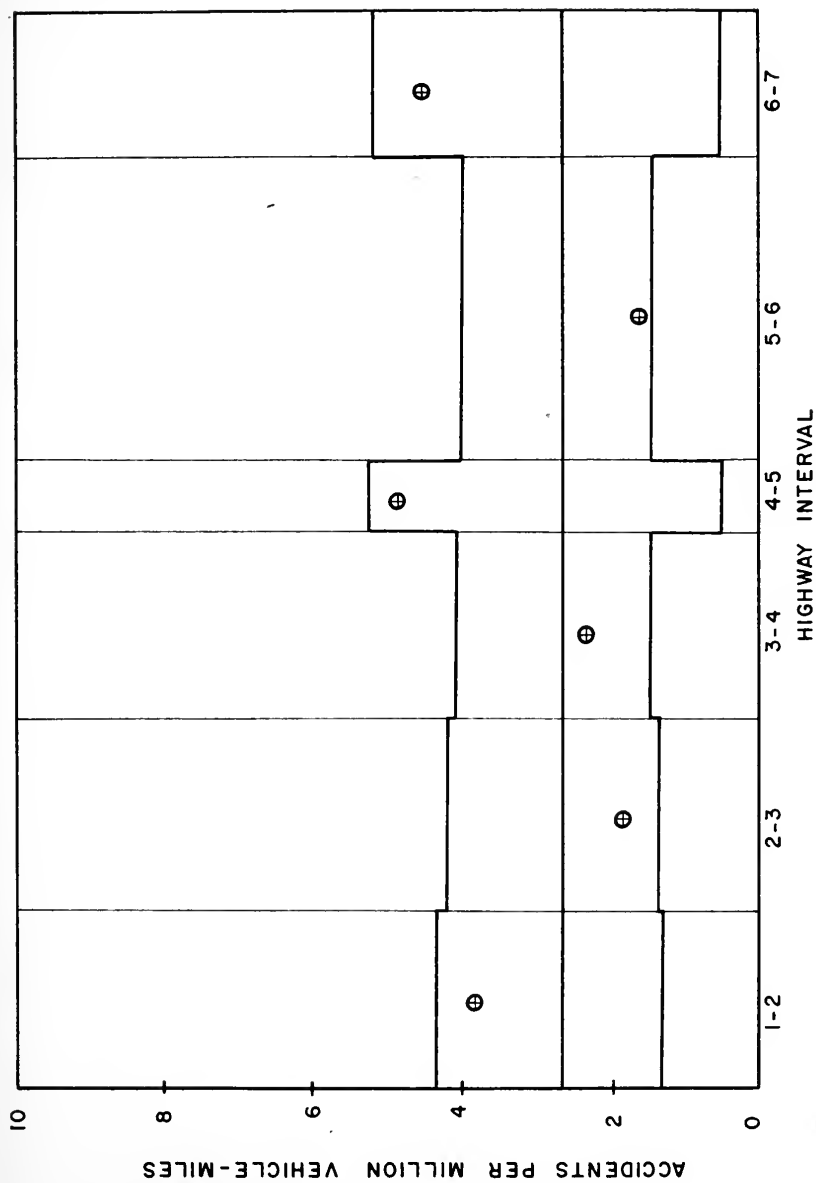


FIG. 37- CONTROL CHART OF SECTION ACCIDENT RATES FOR SOUTHBOUND TRAFFIC DURING 1961, 1962, AND 1963.

a left turning lane at Alto Road would be desirable (see Figure 38).

For section 6-7 numerous accidents have occurred at the crossover where the by-pass makes the transition from a two-lane to a four-lane facility. Most of these accidents occur in the southbound lane of the by-pass. The reason for these accidents appears to be two fold. Either the driver fails to see the crossover signs in time, and/or the driver attempts to negotiate the crossover at a speed which is excessive for the design. Better signing and a more gradual crossover might minimize the hazard at this location.

When the speed-delay data were being collected on the Kokomo By-pass, a high variability in speeds between vehicles was observed. To confirm this observation an electromatic radar meter was used to obtain traffic speed data at various locations along the by-pass. Vehicles on the by-pass were divided into local (Howard County) and non local (non Howard County). The portion of the facility where speed data were collected had a speed limit of 55 miles per hour. The results of the speed study are as follows:

Howard County Vehicles

Standard Deviation - 10.8

Average Speed - 43.6 mph

Non-Howard County Vehicles

10.6

52.6 mph

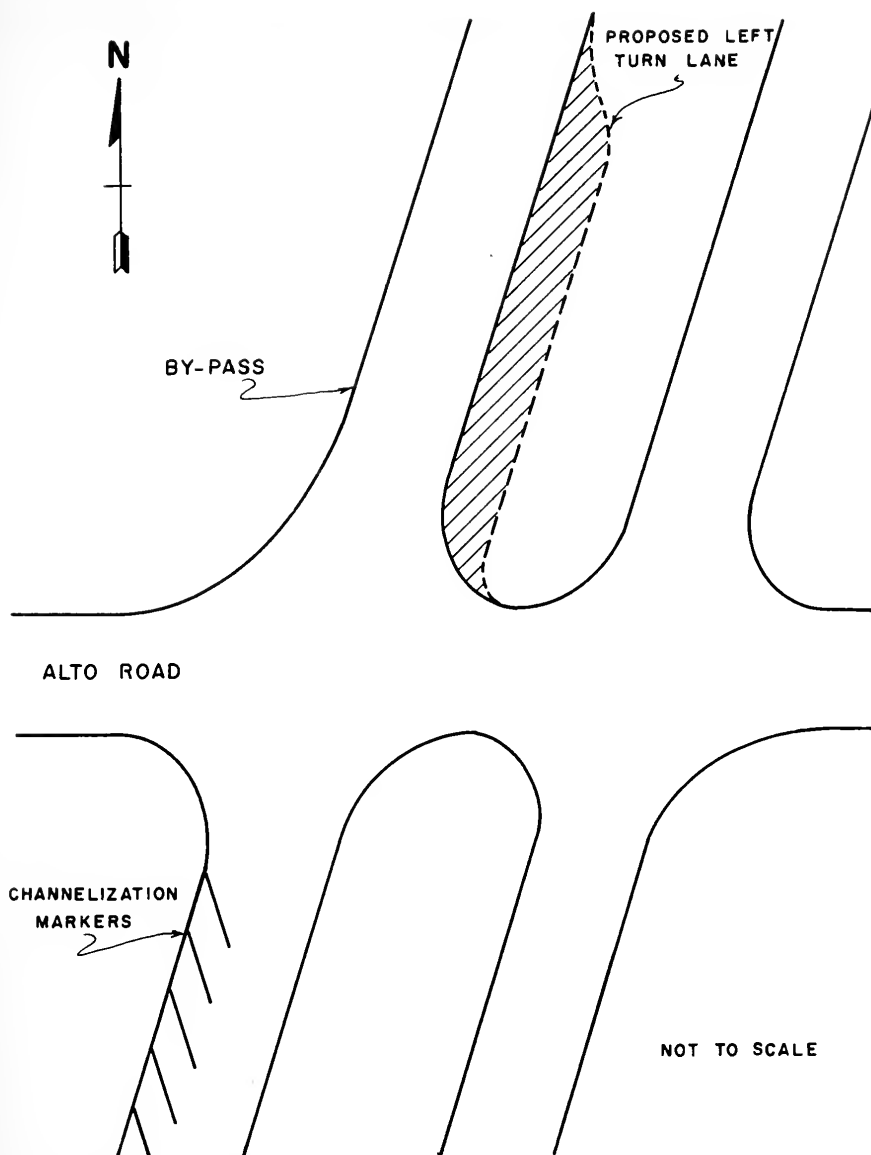


FIG. 38- PROPOSED ADDITION OF A LEFT TURNING LANE ON THE KOKOMO BY-PASS AT ALTO ROAD.

Howard County and Non-Howard County Vehicles Combined

Standard Deviation - 11.5

Average Speed - 47.7 mph

The statistical Student's t-test was used to determine if a significant difference existed between the speeds driven by local and non-local drivers.

Equations are as follows:

$$H : \mu_1 = \mu_2$$

$$H_o : \mu_1 \neq \mu_2$$

Let $\alpha = .05$

$$s_p^2 = \frac{(x_1 - \bar{x}_1)^2 + (x_2 - \bar{x}_2)^2}{n_1 + n_2 - 2}$$

$$= \frac{2691.84 + 2121.0}{24 + 20 - 2} = 114.59$$

$$s^2(\bar{x}_1 - \bar{x}_2) = s_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right) = 114.59 \left(\frac{1}{24} + \frac{1}{20} \right) = 10.50$$

$$s(\bar{x}_1 - \bar{x}_2) = 3.24$$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s(\bar{x}_1 - \bar{x}_2)} = \frac{43.6 - 52.6}{3.24} = -2.78$$

$$t_{.95(C.R.)} = 2.074$$

Where

H = Hypothesis

μ = Population mean

\bar{x} = Sample mean

α = Probability of Type I Error

s_p^2 = Pooled estimate of the variance of the two populations

$s^2(\bar{x}_1 - \bar{x}_2)$ = Estimate of the variance of the difference between the two sample means.

The results of the ~~t-test~~ show that a significant difference exists between the speeds driven by Howard County and non-Howard County drivers. This variability in speeds is believed to be a major factor contributing to the high accident involvement rates on the Kokomo By-pass.

For the final phase of the accident analysis the accidents were classified by type as follows (11):

Type I - Intersection accidents which occur at the crossing of two traffic streams. These accidents are typically right-angle, turning, and rear-end collisions.

Type II - Marginal accidents which occur along the moving edge of a traffic stream. These accidents result from vehicles attempting

to enter or leave the traffic stream.

Typical accidents are rear-end and access collisions.

Type III - Medial accidents which occur between vehicles moving in opposite directions. Head-on collisions and side-swipes are typical accidents of this type.

Type IV - Interstream accidents which occur among vehicles moving in the same direction. These include such miscellaneous accidents as running off the road, overturning, and some rear-end collisions. This type of accident will occur on any facility.

With the above classification accidents can effectively be related to the design of a facility and alterations in the design often can be suggested.

A highway facility with controlled access and grade separations will theoretically eliminate types I and II collisions while a divided highway facility will virtually eliminate type III collisions. Figure 39 illustrates the accident trend by type. A general increase in the number of types I and II accidents is noted. Type III accidents have decreased appreciably since 1962. This is attributable to the divided facility. Type IV accidents have increased slightly in the period from 1957 through 1964. This type of accident, however, occurs on any type facility.

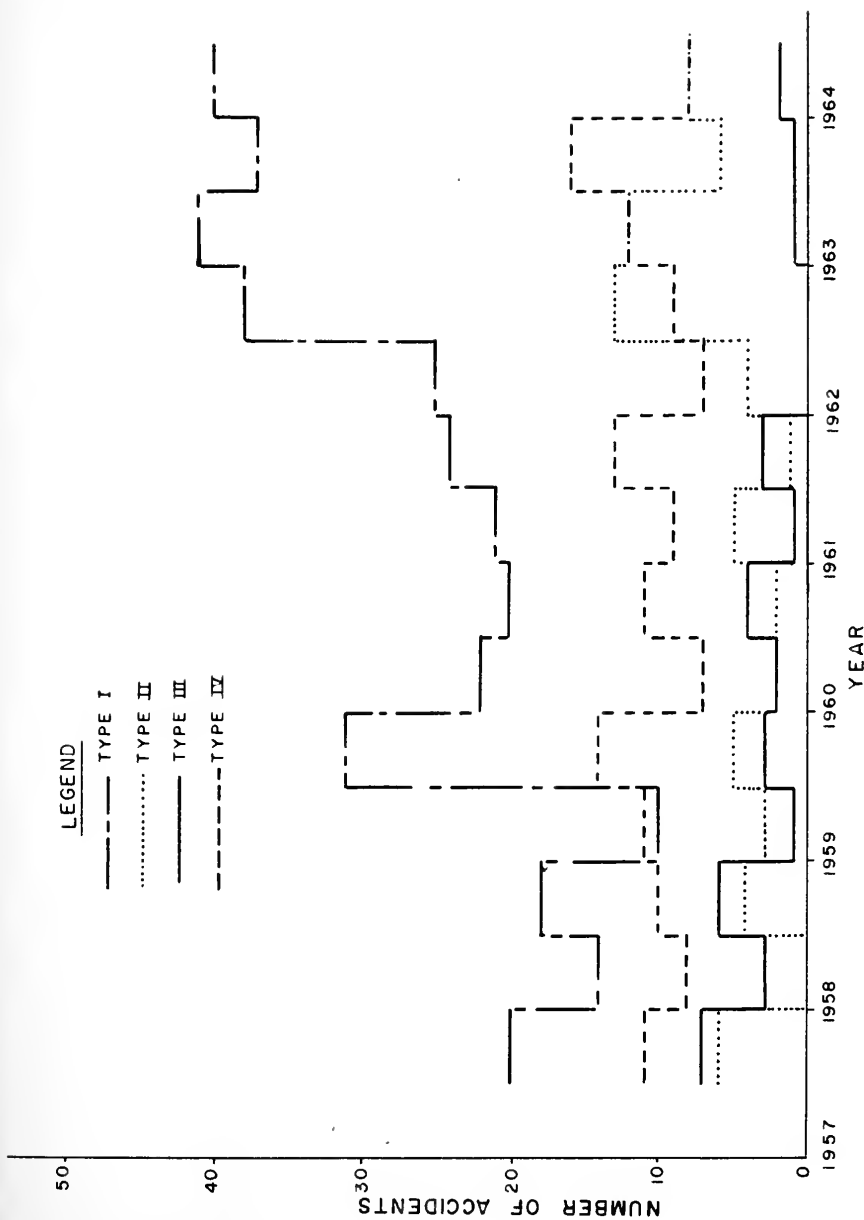


FIG. 39 - NUMBER OF ACCIDENTS BY TYPE AND YEAR

Accident costs by type were considered from July 1957 through June 1964. These include a three year period when the facility was two lanes and a four year period following the opening of the four-lane divided by-pass. The results of this analysis are shown in Table 7. Personal injuries and fatalities were assigned values based on the following statistics (1).

Personal injury - \$660 per person injured

Fatality Age	Cost Per Person	
	Male	Female
0-14 years	\$17,000	\$ 8,000
15-55 years	\$29,000	\$17,000
56 years and older	\$ 5,000	\$ 3,500

A sizeable increase in the costs of types I, II, and IV accidents has occurred in the seven year period, however, the cost of type III accidents has declined when considered on a yearly basis due to the construction of the divided facility.

Since types I and II accidents are virtually eliminated on a controlled access facility with grade separations, an economic analysis was conducted to determine the loss to the motorist because the facility was not of the controlled access type. Another way to visualize this approach is to ask: How much additional money could have been economically spent in 1950 for a controlled access facility which would have

TABLE 7

ACCIDENT COST ON KOKOMO BY-PASS

2 Lane Facility July 1957 - June 1960 (3 years)		4 Lane Divided Facility July 1960 - June 1964 (4 years)	
TOTALS		TOTALS	
0 - Fatalities	\$	1 - Fatality	\$
85 - Personal Injuries	56,100	191 - Personal Injuries	126,060
170 - Property Damages	<u>114,331</u>	284 - Property Damages	<u>258,361</u>
Annual Average Cost	\$ 170,431	Annual Average Cost	\$ 401,421
	\$ 56,810		\$ 100,355
TYPE I		TYPE I	
0 - Fatalities	\$	1 - Fatality	\$
56 - Personal Injuries	36,960	143 - Personal Injuries	94,740
86 - Property Damages	<u>70,422</u>	169 - Property Damages	<u>170,279</u>
Annual Average Cost	\$ 107,382	Annual Average Cost	\$ 282,019
	\$ 35,794		\$ 70,505
TYPE II		TYPE II	
0 - Fatalities	\$	0 - Fatalities	\$
4 - Personal Injuries	2,640	13 - Personal Injuries	8,580
17 - Property Damages	<u>8,745</u>	39 - Property Damages	<u>22,778</u>
Annual Average Cost	\$ 11,385	Annual Average Cost	\$ 31,358
	\$ 3,795		\$ 7,840

TABLE 7 (continued)

2 Lane Facility July 1957 - June 1960 (3 years)	4 Lane Divided Facility July 1960 - June 1964 (4 years)
--	--

TYPE III

0 - Fatalities		0 - Fatalities	
13 - Personal Injuries	\$ 8,580	4 - Personal Injuries	\$ 2,640
17 - Property Damages	<u>12,245</u>	11 - Property Damages	<u>19,250</u>
Annual Average Cost	\$ 20,825	Annual Average Cost	\$ 21,890
	\$ 6,942		\$ 5,473

TYPE IV

0 - Fatalities		0 - Fatalities	
12 - Personal Injuries	\$ 7,920	31 - Personal Injuries	\$ 20,460
50 - Property Damages	<u>22,919</u>	64 - Property Damages	<u>45,694</u>
Annual Average Cost	\$ 30,839	Annual Average Cost	\$ 66,154
	\$ 10,280		\$ 16,539

eliminated types I and II accidents? The assumptions and results are presented in Table 8. The evaluated economic loss from 1953 through June 1964 due to types I and II accidents was \$469,000. Accident data were not available for 1951 and 1952. A similar tabulation is shown for Types I, II, and III accidents in Table 9.

Had the by-pass been constructed with full control of access in 1950, types I and II accidents would have been virtually eliminated. From Table 8 it is clear that at least an additional \$469,000 could have been economically spent in 1950 for the purchase and construction of full access control.

When the economic loss due to accidents on the Kokomo By-pass and the loss due to the increase in travel time required to traverse the by-pass are added (see section of this report entitled Travel Time), it appears that the additional funds required to construct a controlled access facility in 1950 would have been justified. Currently, unless access rights are acquired along the by-pass, which would be very costly, the economic loss to the motorist in the future appears to be even greater since the travel time required to traverse the by-pass and the accident rate are likely to increase.

TABLE 8

PRESENT WORTH VALUE FOR 1950 OF TYPE I AND II ACCIDENTS

Assumptions:

1. Losses include property damage, personal injuries, and deaths attributed to vehicle accidents.
2. Yearly losses have been converted to 1950 present worth values.
3. Interest rate was assumed to be 4 percent.

<u>YEAR</u>	<u>1950 PRESENT WORTH VALUE</u>
1953 - June 1957*	\$ 192,796
1957 (1/2 year)	15,434
1958	17,407
1959	27,827
1960	32,548
1961	44,951
1962	48,436
1963	69,429
1964 (1/2 year)	20,208
Total	<hr/> \$ 469,036

* From Reference 18 converted to 1950 present worth value.

Values for each year were not available.

TABLE 9

PRESENT WORTH VALUE FOR 1950 OF TYPE I, II, AND III ACCIDENTS

Assumptions:

1. Losses included property damage, personal injuries, and deaths attributed to vehicle accidents.
2. Yearly losses have been converted 1950 present worth values.
3. Interest rate was assumed to be 4 percent.

<u>YEAR</u>	<u>1950 PRESENT WORTH VALUE</u>
1953 - June 1957*	\$ 278,215
1957 (1/2 year)	17,915
1958	23,302
1959	31,196
1960	36,730
1961	54,808
1962	48,436
1963	70,360
1964 (1/2 year)	21,675
Total	<hr/> \$ 582,637

* From Reference 18 converted to 1950 present worth value.
Values for each year were not available.

LAND USE

With the variety of development that occurs along a new facility it is frequently difficult to determine which developments are a result of the new route and which would have been present had the facility not been constructed. Reasons for establishments along the Kokomo By-pass, however, seem to be more clearly defined. Most of the commercial and industrial developments in the vicinity of the by-pass either cater directly to the motoring public or are dependent on the accessibility provided by the by-pass.

Land use patterns have been compiled to more clearly portray the land use change within one mile of the by-pass. Land use patterns prior to 1958 were obtained from previous reports while the 1964 land use pattern was obtained from a mosaic of the study area and by field reconnaissance.

A chronological study of land use adjacent to the Kokomo By-pass from 1938 through 1964 shows that prior to the construction of the by-pass the area was predominantly agricultural (see Figure 40) (14). No appreciable changes in land use took place in the area of the present by-pass from 1938 to 1948 (see Figure 41) (14).

During the construction of the Kokomo By-pass businessmen began exploiting the economic enhancements which the

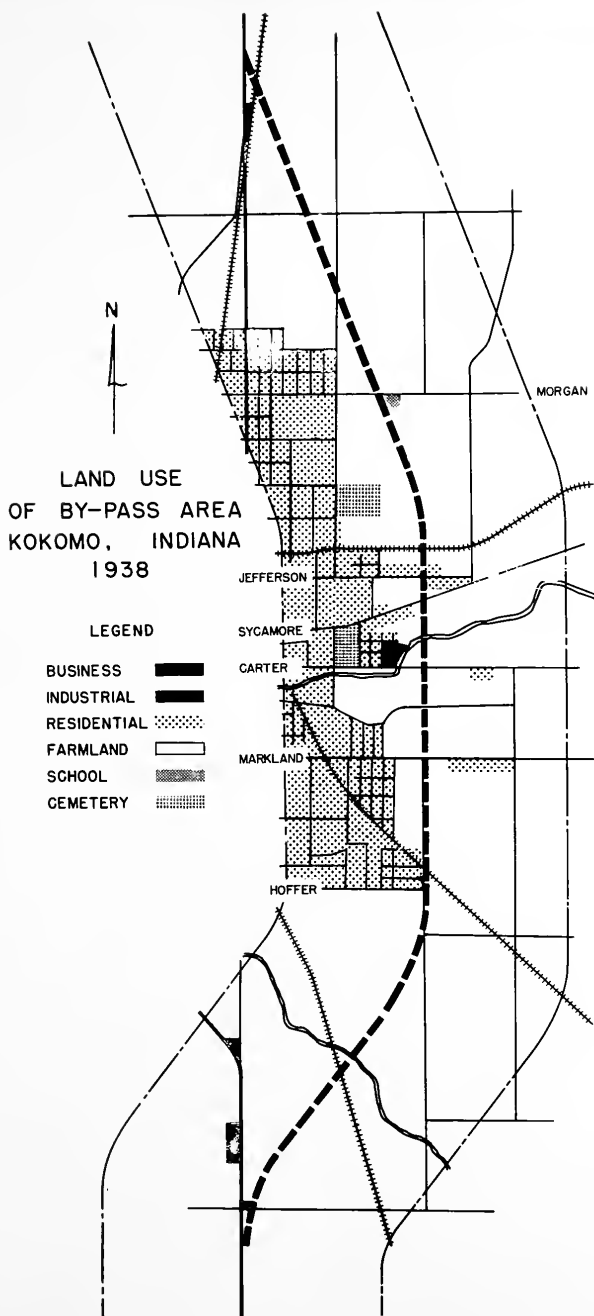


FIGURE 40

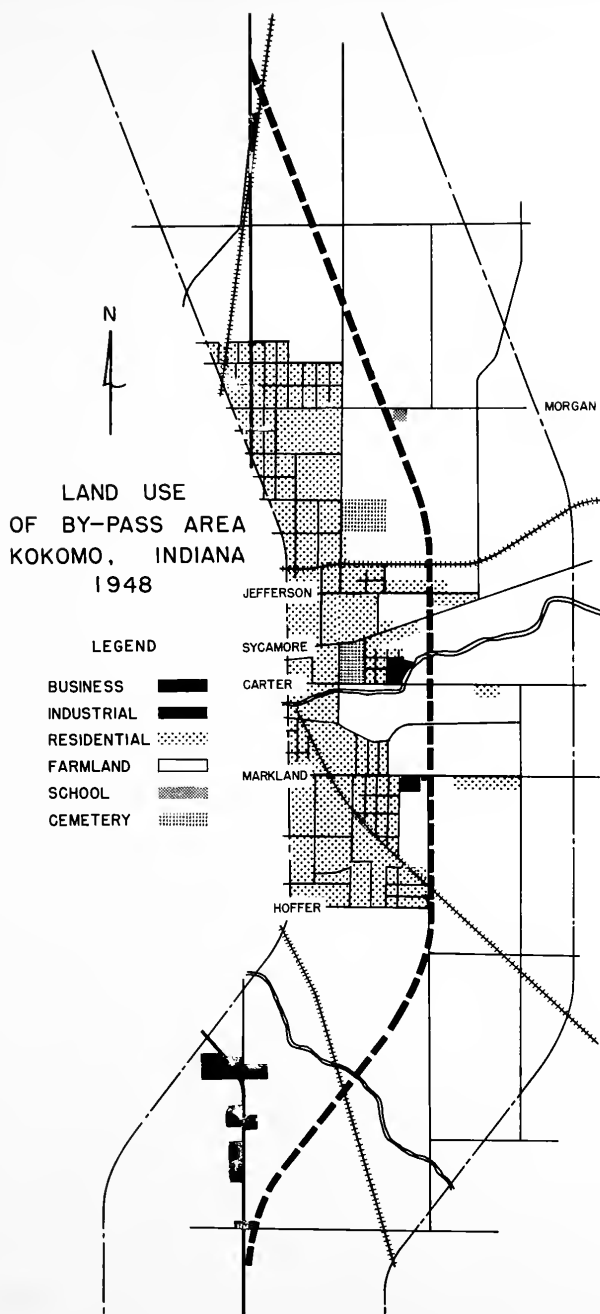


FIGURE 41

by-pass was certain to provide, and by 1951 development had occurred at the intersection of Markland and Sycamore Streets with the by-pass (see Figure 42) (14).

By 1957 much of the new development in and near Kokomo had shifted to the immediate vicinity of the by-pass (see Figure 43) (18). This development included commercial, industrial, and residential establishments. Probably the most significant factor influencing the development along the by-pass was the accessibility provided by the facility.

Figure 44 shows the 1964 development within one mile of the Kokomo By-pass. Large numbers of the establishments adjacent to the by-pass are commercial and industrial although several subdivisions have been platted and developed adjacent to the by-pass. At the present time the land within the area one mile west of the by-pass has the highest demand, and this demand is reflected in sale prices.

Much of Kokomo's new development is occurring to the east of the city. The recently built Chrysler and Delco Radio industries have a sizeable number of employees, and from the rapid residential growth near these two industries it appears that employees desire to live near the place where they are employed. Chrysler and Delco are both clean industries which are not objectionable from the home owners point of view.

Figure 45 shows the zoning plan for the Kokomo By-pass area. Considerable commercial and industrial sites are currently undeveloped.

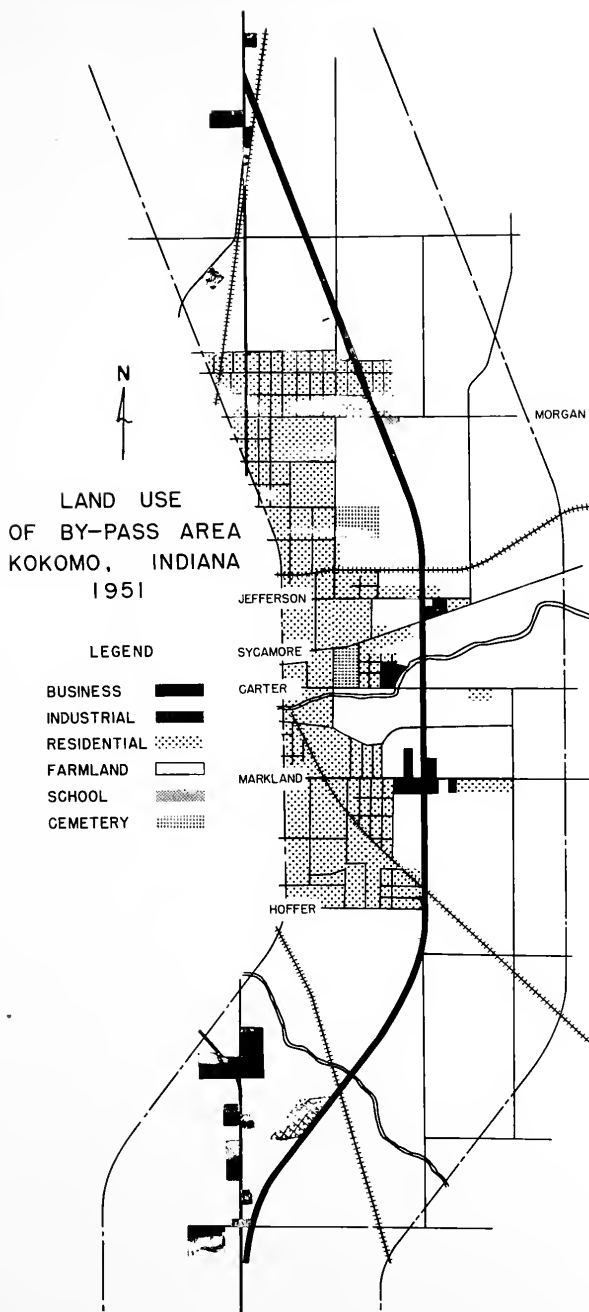


FIGURE 42

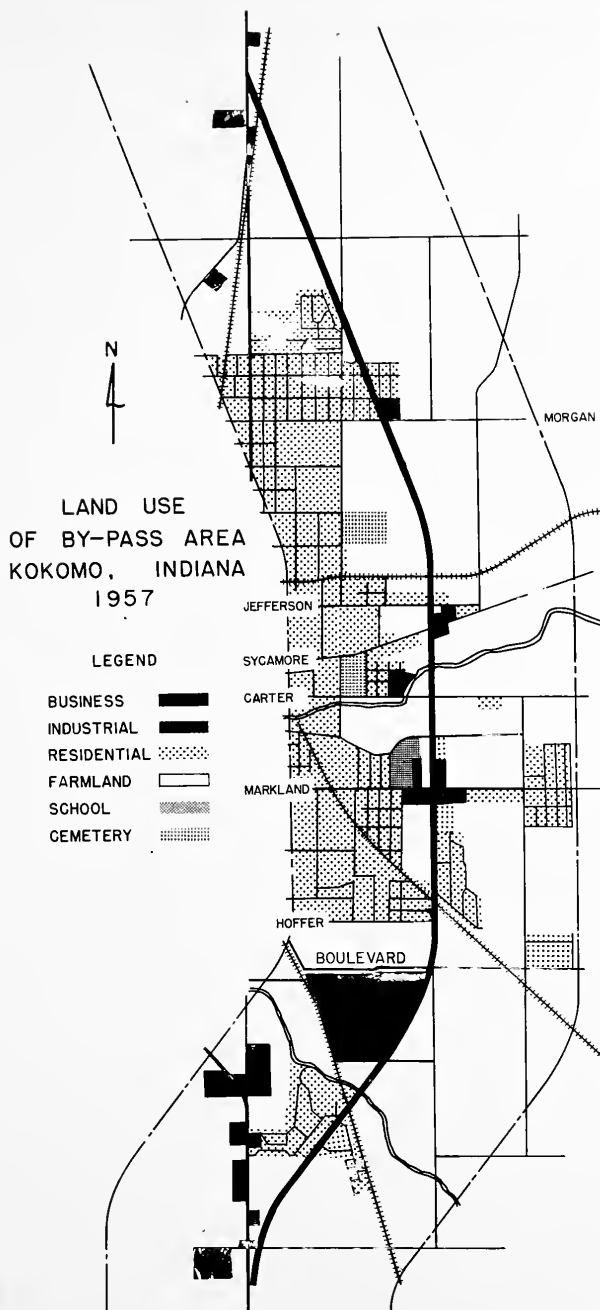


FIGURE 43

LAND USE
OF BY-PASS AREA
KOKOMO, INDIANA
1964

LEGEND

BUSINESS
INDUSTRIAL
RESIDENTIAL
FARMLAND
SCHOOL
CEMETERY

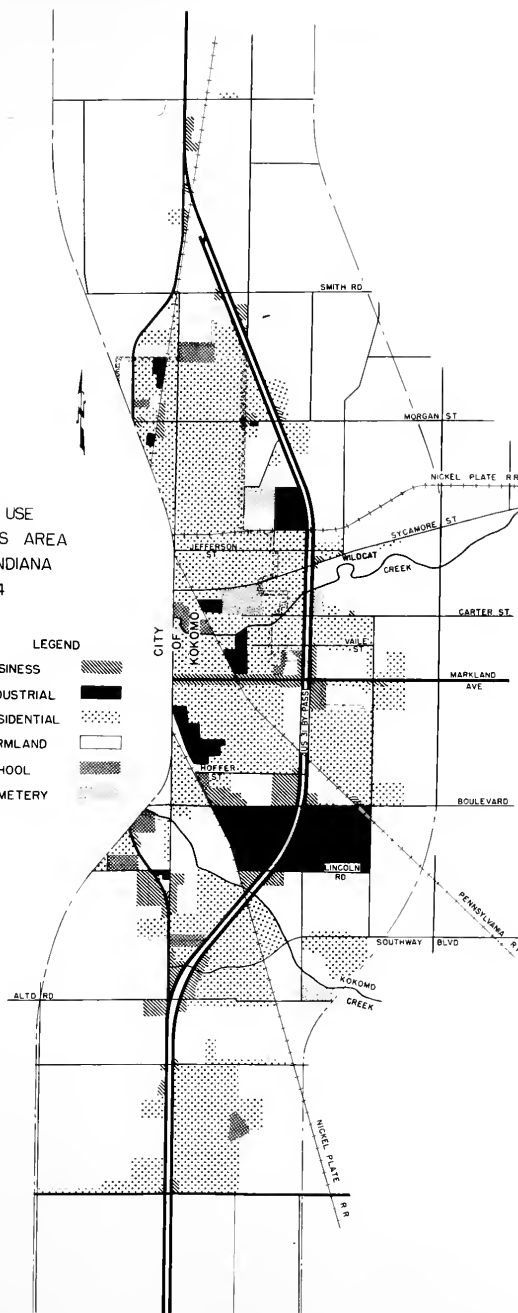


FIGURE 44



ZONING PLAN
OF BY-PASS AREA
KOKOMO, INDIANA

LEGEND

BUSINESS

INDUSTRIAL

RESIDENTIAL

FARMLAND

SCHOOL

CEMETERY

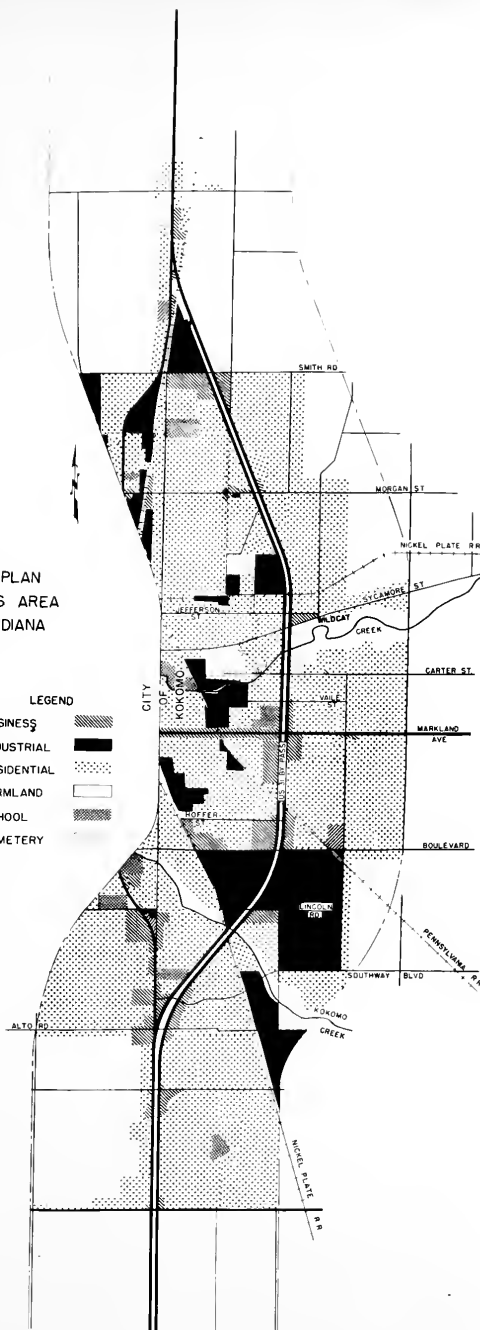


FIGURE 45



With regard to the development that has taken place along the by-pass, the Kokomo City Plan Commission and the Howard County Plan Commission, in cooperation with the Indiana State Highway Commission should be commended for their fine effort in controlling the development and access along the by-pass so as to keep the facility as functional and efficient as possible. Without the most noble effort of the Planning Commission and the State, the Kokomo By-pass would most certainly have already become another city street with undesirable characteristics of congestion, a high accident rate, and increased travel time.

A field check was made to determine what types of establishments existed adjacent to the Kokomo By-pass. For this part of the analysis only business and industrial sites were considered. A list of these establishments is shown in Table 10. The growth of commercial and industrial development along the by-pass is obvious.

Since the Kokomo Mall Shopping Center contains 22 individual units a further breakdown of the establishments within the center is as follows:

Service Station	2	Junior Dept. Store	3
Grocery Store	2	Jewelry Store	1
Novelty Shop	1	Variety Store	2
Liquor Store	1	Shoe Store	3
Men Clothing	1	Hardware Store	2
Finance Dept.	2	Beauty Salon	1
Barber Shop	<u>1</u>		<u> </u>
Sub-Total	10	Total	22



TABLE 10
ESTABLISHMENTS ADJACENT TO THE KOKOMO BY-PASS

	<u>1951</u>	<u>1957</u>	<u>1964</u>
Motels and Motor Lodges	--	3	5
Restaurants and Drive-ins	1	3	5
Service Stations	1	6	7
Used Car Lots	1	2	2
Retail Outlets	--	1	3
Grocery and Fruit Stands	--	1	1
Garages	--	2	3
Mobile Home Sales Lots	--	--	2
Repair Shops	1	1	6
Shopping Centers	--	--	1
Fire Stations	--	--	1
Office Buildings	--	--	3
Hospitals	--	--	1
Car-Washes	--	--	1
Laundries	--	--	1
Industries	<u>--</u>	<u>--</u>	<u>2</u>
Total	4	19	44



The 44 establishments which front on the Kokomo By-pass have 33 access drives entering directly onto the by-pass. The major traffic generators, however, channel their heavy volume loads onto a collector street rather than directly onto the by-pass, and again the Kokomo Planning Commission and Indiana State Highway Commission must be commended for their guidance in this respect.

Some of the establishments which are located in the vicinity of the by-pass are shown in Figures 46-59. Chrysler and Delco Radio are the two most important traffic generators along the by-pass, and neither industry has ingress nor egress from the employee parking lot directly onto the by-pass.

Even though the Kokomo City Plan Commission, the Howard County Plan Commission, and the Indiana State Highway Commission have made a most desperate effort to preserve the operational efficiency of the by-pass, it appears that it is impossible to fully retain the desirable characteristics of an urban by-pass by anything other than full control of access.





FIG. 46 - MOTEL AT INTERSECTION OF BY-PASS AND
LINCOLN ROAD

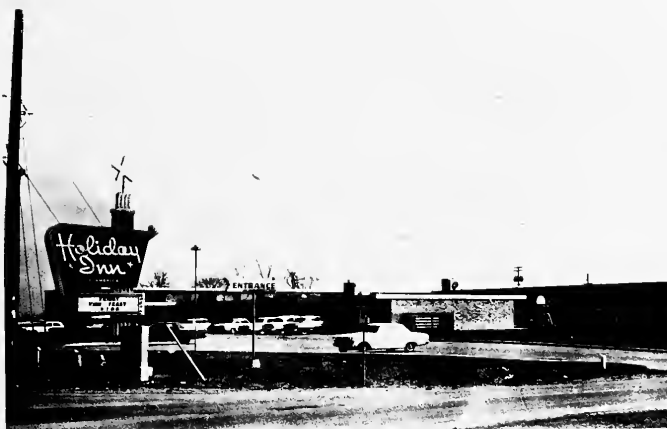


FIG. 47 - MOTEL AT INTERSECTION OF BY-PASS AND
EAST BOULEVARD





FIG. 48 - HOSPITAL AT SOUTH END OF BY-PASS



FIG 49 - FIRE STATION AT INTERSECTION OF BY-PASS
AND EAST BOULEVARD



FIG. 50 - PORTION OF SHOPPING CENTER LOCATED
AT INTERSECTION OF BY-PASS AND EAST
BOULEVARD



FIG. 51 - SHOPPING CENTER LOCATED AT INTERSECTION
OF BY-PASS AND EAST BOULEVARD





FIG. 52 - FACTORY LOCATED AT INTERSECTION OF
BY-PASS AND EAST BOULEVARD



FIG 53 - FACTORY LOCATED NEAR INTERSECTION
OF BY-PASS AND LINCOLN ROAD





FIG.54 - DRIVE-IN RESTAURANT LOCATED
AT INTERSECTION OF BY-PASS
AND U. S. 35



FIG.55 - DRIVE-IN RESTAURANT LOCATED AT
INTERSECTION OF BY-PASS AND HOFFER
STREET



FIG. 56 - NEWSPAPER OFFICE SOUTH OF
INTERSECTION OF BY-PASS AND
SOUTHWAY BOULEVARD



FIG. 57 - MOTEL LOCATED AT INTERSECTION OF
BY-PASS AND SOUTHWAY BOULEVARD





FIG 58 - DEPARTMENT STORE AT INTERSECTION OF
BY-PASS AND ALTO ROAD



FIG.59 - DEPARTMENT STORE NEAR INTERSECTION OF
BY-PASS AND U.S. 35



LAND VALUE

After the location of a new highway has been determined, one of the first problems is that of purchasing right-of-way for the improvement. In the past controversies have arisen with respect to the impact which a new highway has on the surrounding area. Some have felt that the property owner often suffers a loss while others insist that the owner usually receives a substantial enhancement if only a portion of the property is taken.

A number of studies underway at the present time are attempting to resolve this controversy. If the property owner is not being compensated justly for the portion taken, findings from this research might prove beneficial to right-of-way acquisition departments.

The first phase of the land economic analysis considered land value changes within the Kokomo vicinity while the second phase analyzed properties which are partially taken for the right-of-way of the by-pass.

In the first portion of the study it was necessary to code all parcels of land within the Kokomo city limits and all parcels of land in the rural area which were within 3 miles of the Kokomo By-pass. After each parcel within the study area had been assigned a number, a random sample of

the parcels was selected for analysis.

The data for the analysis were collected from the Court-house in Kokomo, Indiana. These data were obtained from both the Auditor's and the Recorder's Office. A chronological outline of the procedure used in collecting the land value data is as follows:

1. The parcel in question was located with respect to Section, Township, and Range by viewing a county map located in the Auditor's Office.
2. Once the Section, Township, and Range had been identified, the names of property owners were obtained from the plat books (located in the Auditor's Office.)
3. After the name of the property owner had been determined, the property was traceable through time in the transfer books which were also located in the Auditor's Office. The transfer books were catalogued by increments of time. Usually a set of transfer books was available for each township and each city within the county. If the property owner column in the transfer book was the only column filled, then the property in question had not been transferred during the interval of time covered by that book. Other pertinent data, such as, date of transfer, date of death, assessed value, and acreage were located in the transfer book.



4. With knowledge of the transfer, the analyst would next locate the appropriate deed in the general index which consists of two books - grantee and grantor. The general index is located in the Recorder's Office. Transfers were listed in the general index by alphabetical or chronological order. From the coding system in the general index the deed record book containing the parcel in question was found. The deed contained data pertinent to the sale of the property, such as, property description, U. S. Revenue Tax Stamps, and mortgages. From the revenue tax stamps and mortgages the sale price of the parcel in question was determined.

When real estate is sold, the transfer plus a sale value are reported to designated county offices. The sale price as recorded on the deed may include a monetary consideration and a mortgage which the buyer assumed from the seller. The buyer pays a Federal Revenue Tax only on the monetary consideration. The inferred price for property when a monetary consideration was paid and a mortgage was assumed, was the monetary consideration, which was inferred from the revenue tax stamp, plus the amount of the mortgage. When the buyer did not assume a mortgage from the seller, the inferred price for the property was the monetary value as obtained from the value of the revenue tax stamps.

The Federal Revenue Tax Stamps are available in 55 cent increments, and each 55 cents represents a range of \$500 - except for the first increment. Examples of tax stamp values are as follows:

<u>Tax Stamp</u>	<u>Liquid Monetary Value</u>
\$ 0.55	\$100 to 500
1.10	\$500 to 1,000
1.60	\$1,000 to 1,500
22.00	\$19,500 to 20,000
n	X_1 to X_2

In this study the tax stamps were assumed to represent the median value of the possible monetary range. An example is as follows:

<u>Tax Stamp</u>	<u>Possible Range of Monetary Values</u>	<u>Assumed Monetary Value</u>
\$22.00	\$19,500 to 20,000	\$19,750

Previous research by Fletcher (8) indicated that inferred values from Federal Revenue Tax Stamps gave a reliable estimate of sale prices. In the land value analysis the assessment values were not used because assessed values have been found to vary considerably from sale price values (8).

After the land value data were collected, it was stratified into five bands, each one mile in width. These bands are as follows (see Figure 60):

Band I - 2 to 3 miles west of the by-pass

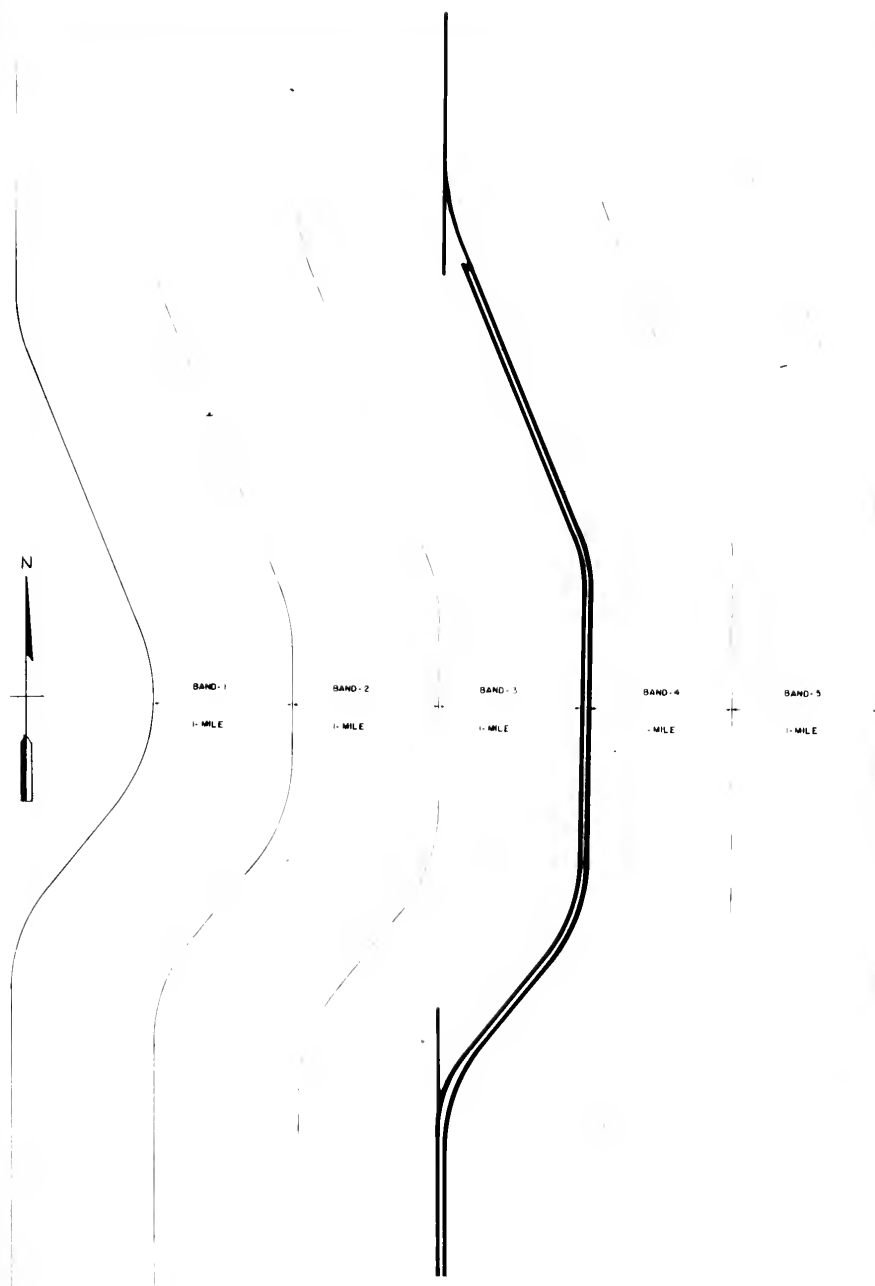


FIG. 60 - LAND VALUE BANDS PARALLEL TO THE BY-PASS

- Band II - 1 to 2 miles west of the by-pass
- Band III - 0 to 1 mile west of the by-pass
- Band IV - 0 to 1 mile east of the by-pass
- Band V - 1 to 2 miles east of the by-pass

Table 11 shows the summary of the land value analysis by band width and by years. The mean sale price per acre, the range in sale values, and the number of parcel sales are tabulated in Table 11. All parcels analyzed and tabulated in Table 11 were for land without improvements thereon.

Figure 61 portrays the increase in mean land value for the five bands. Band I includes the land area on the west side of Kokomo that is in a comparable location to the city as is the by-pass area on the east. It might reasonably be considered a control for suburban land values as it was not influenced by a highway improvement. An almost linear increase in value was observed.

Land in band II, which includes the central portion of Kokomo, did not increase in value in the period 1951-56 as much as land in band I, the suburban area, but the increase in value 1957 - 63 was much greater. This increase in land value in the central area of the city after 1956 may have been due to improved economic conditions in the city, and it may have also been due to exploitation by businessmen of areas along old U.S. 31 which were readily accessible to local traffic following the construction of the by-pass.

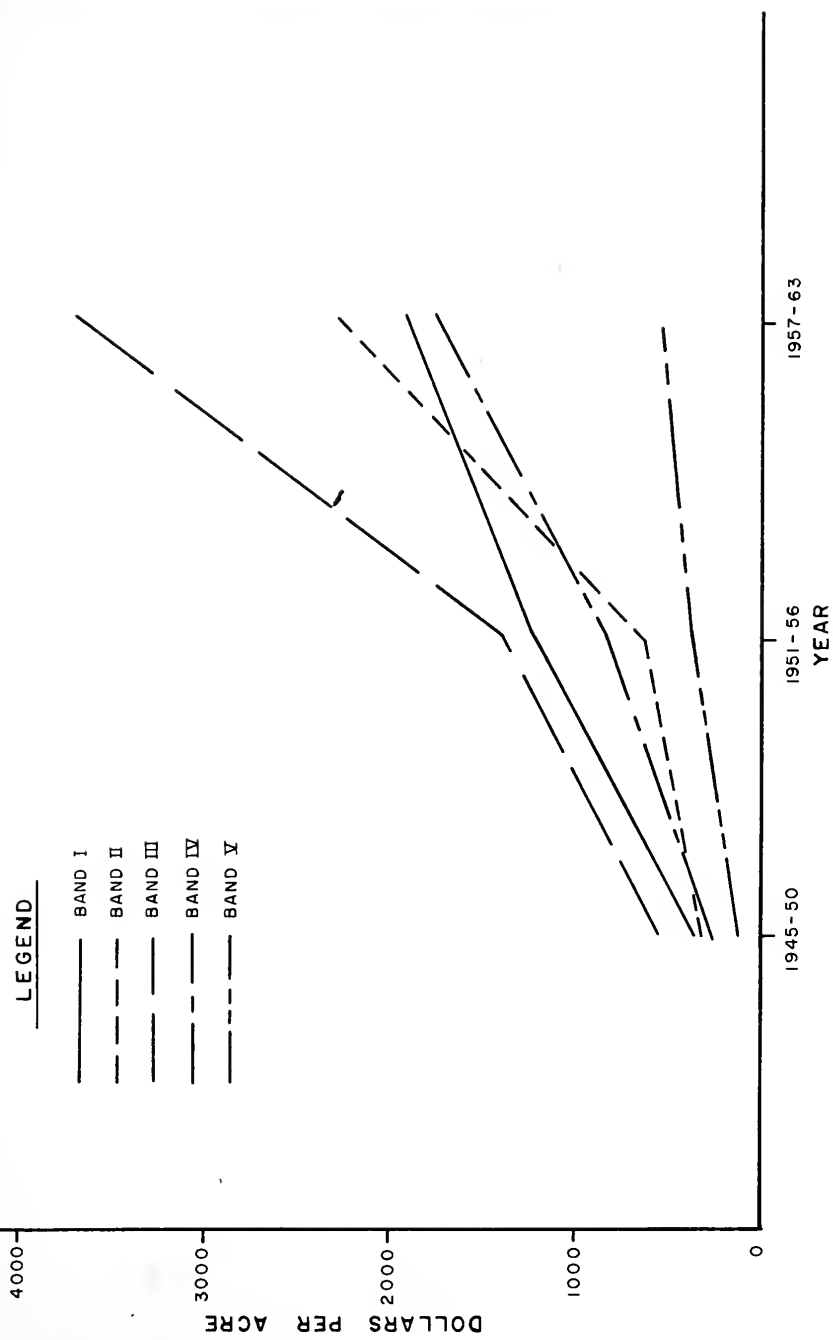


FIGURE 61 - MEAN VALUE PER ACRE OF LAND ALONG KOKOMO BY-PASS

TABLE 11

SUMMARY OF VALUES FOR UNIMPROVED LAND 1945 - 1963

Years 1945-50

Band	Sale Price Per Acre (Dollars)		No. of Sales
	Mean Value	Range	
I	\$ 349	\$ 94 - 27,000	32
II	318	112 - 8,333	32
III	549	161 - 14,394	88
IV	263	165 - 3,000	31
V	115	97 - 2,750	9

Years 1951-56

Band	Sale Price Per Acre (Dollars)		No. of Sales
	Mean Value	Range	
I	\$ 1,206	\$ 197 - 30,700	36
II	626	322 - 10,000	28
III	1,354	125 - 36,250	108
IV	817	71 - 26,250	59
V	379	207 - 3,410	11

Years 1957-63

Band	Sale Price Per Acre (Dollars)		No. of Sales
	Mean Value	Range	
I	\$1,903	\$243 - 27,500	21
II	2,295	107 - 15,000	56
III	3,660	309 - 28,636	63
IV	1,733	295 - 113,888	87
V	510	397 - 5,000	8

Land in band III has been in the highest demand. This illustrates the fact that in the period 1951-1963 much of Kokomo's new development has occurred between the by-pass and the city. The area which has been most important in contributing to the increasing land values in band III was the property in the southern half of band III where considerable industrial and commercial activity has occurred. The accessibility provided by the by-pass was, with little doubt, the primary reason for these developments.

Band IV, the land east of and adjacent to the by-pass, shows a less pronounced increase in property values from 1951 to the present than that experienced by land in band III. Much of the development in band IV has been residential which might partially explain the smaller increase in land values.

Band V, the land more than one mile east of the by-pass, shows the steady increase of rural land values in Howard County and possibly was not affected by the highway improvement.

From Figure 61 it is seen that the by-pass has had a positive effect on land values within one mile of the by-pass. Some of the property owners near the Kokomo By-pass have received sizeable enhancements which can certainly be attributed to the presence of the by-pass. Therefore, from this study it is concluded that a noncontrolled access by-pass

does have a beneficial effect on property values in the immediate area of the facility. This impact is affected by the distance from the facility and by the location of the city.

REMAINDER PARCEL STUDY

The intent of this phase of the land value analysis was to determine if both the property owner and the State had been equitably treated for the land and/or improvements taken for the by-pass right-of-way. Nine selected properties were used for the case studies (see Appendix). Ideally each study property should have been sold prior to the time when the land was acquired for the Kokomo By-pass, and each remaining parcel should have been sold following the acquisition date.

Seldom were all the above requirements met; therefore, simplifying assumptions were necessary in some case studies when either a "before" value or an "after" value of the parcel was not available. Since appraisals in 1947 and 1948 were made of only the portion of the property taken for the right-of-way of the by-pass instead of an appraisal of the entire property as is done today, a "before" sale from 1945 through 1947 was desirable.

An "after" value was obtained when the property owner sold the land either as a whole unit or as small parcels. These "after" sale values were "adjusted" to a 1948 monetary value so that all sales could be compared on a common basis.



"After" sale values were adjusted by using the percentage change in land value from band V in Figure 61. It is believed that band V most nearly represents the normal increase in land value with time. It is felt that this method of adjustment gave "adjusted" sale values to a 1948 base which are conservative.

The results indicate that the most significant increases in land value occur when land is changed from one use to another (See Case Study Nos. 1, 2, 3, 4, 5, 6, 8, and 9). The change of land from agricultural to industrial or commercial is an example of such a change in land use.

In most of the case studies where data were available for a complete analysis, the property owner received a sizeable enhancement which can be directly attributed to the presence of the Kokomo By-pass. Case Study Nos. 1, 2, 5, 6, and 9 are examples of such considerable enhancements.

It is also clear that the enhancement of property values continues for many years after completion of the highway facility with some "later" increases in value being very significant. Case Study Nos. 2, 7, and 8 support this conclusion very well.



RESULTS

The major results noted in this study are summarized as follows:

1. Travel volumes on the Kokomo By-pass have increased **three** to five fold from 1951 through 1964. Major causes for this growth have been the rapid development of Kokomo in the vicinity of the by-pass, the high trip generating characteristics of the industrial and commercial establishments along the by-pass, and the normal increased use of motor vehicles during that period.
2. In the years from 1951 through 1964 traffic volumes have increased considerably on the streets intersecting the Kokomo By-pass. This has created congestion and delay. This volume increase has also tremendously increased the probability of being involved in an accident for each vehicle on the by-pass.
3. The number of accidents has continually increased on the by-pass even after its reconstruction to a four-lane divided facility in 1960 for much of its length.



4. The four-lane divided facility substantially reduced the type III (medial type) accidents. Some type III accidents still occur, however, but these accidents are confined to the north end of the by-pass which is still a two-lane facility.
5. An accident spot map seems to be a poor measure of the degree of hazard at an intersection. The number of accidents at an intersection does not indicate relative hazard unless it is correlated with the traffic volume for that intersection.
6. The accident hazard formula and the quality control technique produced similar results in the accident analysis. The most hazardous locations were indicated similarly by both methods.
7. The most hazardous intersections on the Kokomo By-pass were found to be in the following order: Sycamore, Jefferson, Southway, Alto, Morgan, Markland, Boulevard, Lincoln, Hoffer, and Smith. The two most hazardous sections were the one which included the Sycamore and Jefferson Street intersections, and the other was most northerly section of the by-pass where only two travel lanes are available.
8. The ~~Autumn~~ and Winter months have the highest accident rate.
9. Travel time required to traverse the city route (old U.S. 31) has increased only slightly from 1951 through 1964.



10. Travel time required to traverse the U.S. 31 By-pass has increased very slightly from 1951 through 1964. Only a slight increase has been possible because of the reconstruction of the by-pass in 1960 to a four-lane divided facility. The increase in travel time, under these conditions, is a direct result of the increasing traffic volumes which has resulted in the installation of traffic signals at three intersections.
11. Delays on the by-pass because of the four railroads crossing at grade were very minor.
12. Two incompatible groups of drivers travel on the by-pass. These groups are local (Howard County) and non-local (non-Howard County) drivers. The analysis showed that there was a significant difference in speeds driven by the two groups of drivers with the local drivers traveling at a significantly lower rate of speed. It is probable that this variability in speed is a major contributor to vehicular accidents.
13. If the by-pass had been constructed as a controlled access facility with grade separations in 1950, an economic accident loss of \$469,000 (1950 present worth value of accidents 1953 - June 1964) probably would not have occurred.



14. The economic loss of travel time to motorists on the Kokomo By-pass was compared with a fictitious Kokomo By-pass of the freeway design. The value of the additional travel time required by motorists to traverse the by-pass in the one year, 1964, was evaluated at \$270,000 because the by-pass facility was not of freeway design.
15. The Kokomo By-pass has had a pronounced effect on the locality of new development at Kokomo. The major growth of Kokomo has been to the east in the vicinity of the by-pass.
16. Development adjacent to the by-pass has been somewhat controlled, and growth has occurred in an orderly manner because of the efforts of the Kokomo and Howard County Planning Commissions and the Indiana State Highway Commission.
17. Land values adjacent to the by-pass increased at a faster rate than land values in any other portion of the Kokomo area.
18. Land values along the city route (old U.S. 31) increased slowly following the construction of the Kokomo By-pass. After 1956 land values in the vicinity of the old city route increased substantially. It is therefore concluded that when considering the long term, the by-pass did not have a detrimental effect on property value along the old city route.



19. From the remainder parcel analysis it was concluded that many of the property owners who had land taken for the right-of-way of the improvement received sizeable enhancements before they sold the remainder parcels.
20. Land which was converted from one use to another showed the larger increases in value. Land converted from agricultural to industrial or commercial uses increased most in value.
21. For several cases the land values of property adjacent to the by-pass were found to increase significantly with time.



RECOMMENDATIONS

From this study the following recommendations are made:

1. From the economical analysis it appears that a fully controlled access facility would have been warranted at Kokomo. Because of this result, it is recommended that all future urban by-passes be of the fully controlled access type unless a careful economical analysis proves otherwise.
2. Additional visibility needs to be provided for east-bound traffic on Sycamore or better warning of the approaching intersection needs to be given. The speed of southbound traffic approaching Jefferson and Sycamore should be slowed by better warning devices. The number of right angle collisions at Sycamore and the by-pass warrant additional traffic engineering measures.
3. A left turning lane is needed adjacent to the south-bound lanes of the Kokomo By-pass at Alto Road. A left turning lane should reduce the number of rear-end collisions which are presently occurring at this location.

4. The crossover at the north end of the by-pass should have better warning controls, or the crossover should be negotiable at a higher rate of speed so that the number of accidents at this location might be reduced.
5. One of the present access entrances to the K-Mart from the by-pass is quite near the Markland and U.S. 31 By-pass intersection. This is creating traffic problems. Access at the south end of the K-Mart tract would cause less delay to the motorist and congestion problems would be less critical.
6. It is evident from the heavy turning volumes of trucks at Smith Road and the by-pass that many truck drivers are using Smith Road and the by-pass as a route around downtown Kokomo when traveling on U.S. 35. An adequate and official truck route for U.S. 35 traffic should be a matter of early study.
7. The impact study of the Kokomo By-pass should be continued for several years. Specifically, the land value study, accident analysis, and study of the travel characteristics of the by-pass should be continued. To facilitate this continuance the following suggestions are offered:
 - a. All property transfers in the Kokomo study area should be kept current. As parcels are sold, more case studies should be developed with detailed land value analysis.



- b. Only accident data recorded on machine-processed cards in a systematic manner by the State Police are necessary for the analysis of accidents.
- c. Because additional signals are likely to be installed on the by-pass in the near future, annual travel time and volume data should be obtained for the by-pass to discern annual changes in travel characteristics.

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APPENDIX

CASE STUDY NO. 1

Location

The subject property was located on both sides of the U.S. 31 By-pass just south of the intersection of U.S. 35 (see Figure 1-1).

"Before" Data

The property was a 60.56 acre parcel which was used as a farm. Improvements existed on this property prior to 1948. The property was not transferred from 1945 to 1947; therefore, a "before" sale value was not available.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass was constructed as a two-lane facility. Enough right-of-way was acquired in the initial taking to permit the addition of two more travel lanes which would complete the planned four-lane divided facility. The by-pass was constructed with little or no control of access.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE I-1

Part Taken

At the time of this taking the Indiana Highway Commission made appraisals of only the part taken for right-of-way purposes. A plat of the subject property showing the part taken and "after" sale tracts is illustrated in Figure 1-2. Damages paid to the property owner in the final settlement are summarized as follows:

fence to be constructed	\$ 250
land in R/W, 3.78 acres	2,500
large sign board	25
3 trees	25
corner cut	50
gravel drive	150
	<hr/>
Total amount paid	\$ 3,000

"After" Data

The first sale of the described tracts are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
"A"	12-1948	0.26	\$ 600
"B"	12-1961	0.5	8,085
"C"	3-1962	14.09	204,268
		<hr/>	<hr/>
Total		14.85	\$ 212,953

Inferred sale values were obtained from U. S. Revenue Tax Stamps. A subsequent sale of tract "B" on May 29, 1963,

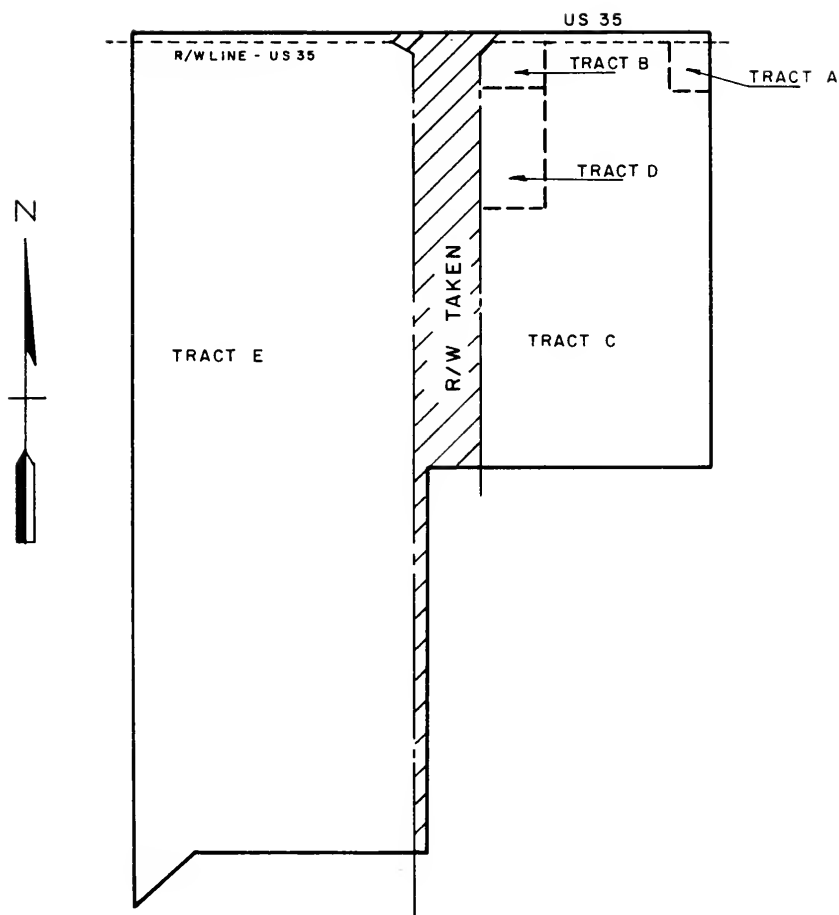


FIG.1-2 -PLAT OF SUBJECT PROPERTY SHOWING R/W TAKEN

indicates that the 0.5 acre parcel sold for an inferred value of \$39,750.

Tract "A" is the site of a camera shop. Tract "B" is the site of a service station. K-Mart is situated on tract "C" while tract "D" is the site of a drive-in. Tract "E" contains two improvements in a small area along U.S. 35 - one of which is a drive-in while the other is a grocery establishment. (see Figures 1-3 through 1-5). No sales have been recorded for tracts "D" and "E" or portions thereof.

Comparison of Sale Values and "Before" Values

Only parcels "A", "B", and "C" were considered for this phase of the analysis. The "Before" value was assumed to be the same as the appraisal value of \$660 per acre since there were no improvements on tracts "A", "B", or "C" prior to 1948. Based on \$660 per acre the "before" value of these tracts was \$9,800. The first sale of remainder parcels "A", "B" and "C" was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" values are summarized as follows:

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
"A"	\$ 600	\$ 445
"B"	8,085	1,770
"C"	<u>204,268</u>	<u>43,300</u>
Total	\$212,953	\$ 45,515



IMPROVMENT LOCATED ON TRACT A



IMPROVMENT LOCATED ON TRACT B

FIG. 1-3 - IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED ON TRACT C



IMPROVEMENT LOCATED ON TRACT D

FIG. I-4-IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED IN NORTHEAST
CORNER OF TRACT E



IMPROVEMENT LOCATED IN NORTHWEST CORNER OF TRACT F

FIG. I-5 - IMPROVEMENTS EXISTING IN 1964

"Before" Value	\$ 9,800
Sale price	212,953
"Adjusted" sale price	<u>45,515</u>
Difference ("Adjusted" less "Before") +	\$ 35,715

Summary

From this case study it is concluded that the property owner received a sizeable enhancement since the apparent "before" value of tracts "A", "B", and "C" was \$9,800, but the "adjusted" sale price showed that the property owner received \$45,515 for these remainder parcels.

CASE STUDY NO. 2

Location

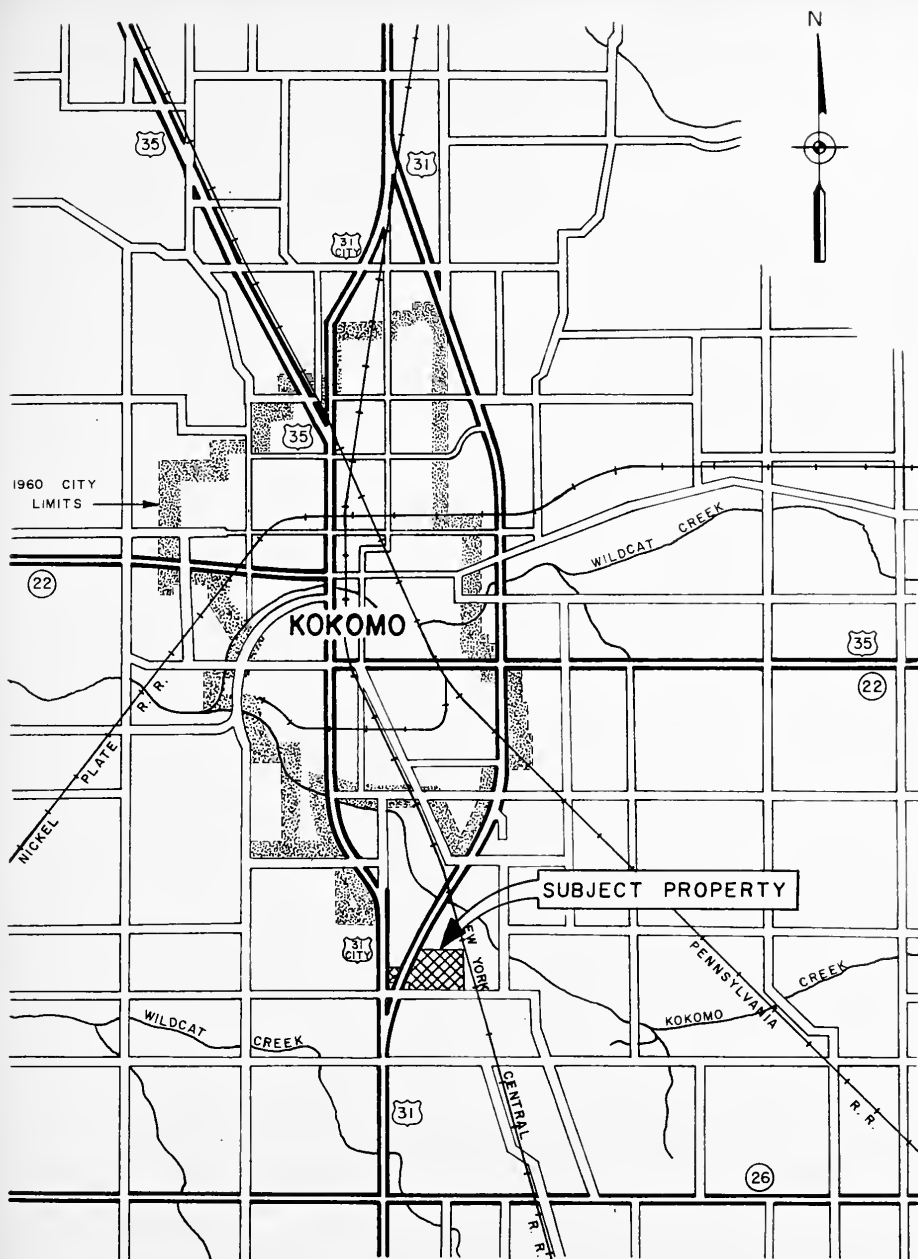
The subject property was located on both sides of the U.S. 31 By-pass with the major portion lying east of the by-pass. The property was situated just north of Alto Road (see Figure 2-1).

"Before" Data

Prior to 1948 the property was a 77.7 acre farm with improvements. Since the property was not transferred from 1945 through 1947, a "before" sale value was not available.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was constructed as a two-lane facility. Enough right-of-way was acquired in the initial taking to permit the addition of two more travel lanes when traffic volumes warranted this addition. The final by-pass was planned as a four-lane divided facility with little or no control of access.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 2-1

Part Taken

At the time of this taking the Indiana Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the part taken and the "after" sale tracts is illustrated in Figure 2-2. Damages paid in the final settlement are summarized as follows:

land in R/W, 5.07 acres	\$1,266
separation of 6.5 acres	650
fence to be constructed	498
Total amount paid	<u>\$2,414</u>

"After" Data

The first sale of the described tracts are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
"A"	9-1948	1.00	\$ 750
"B"	5-1950	1.85	2,250
"C"(Includes C-1 and C-2)	2-1958	72.84	103,613*
"D"	8-1955	1.00	750
"E"	3-1960	1.00	None**
	Totals	77.69	<u>\$107,363</u>

* Stated sale price by buyer or seller for land and some improvements.

** This transfer was to a member of the family with life estate reserved.

The subsequent sales of the tracts were as follows:

	<u>Sale Date</u>	<u>Inferred Value</u>
Tract "A"	7-1950	\$ 300
	9-1954	2,750
	4-1958	9,750
	10-1962	42,000

Tract "A" was sold to an oil company in 1962 as a choice site for a service station.

	<u>Sale Date</u>	<u>Inferred Value</u>
Tract "B"	10-1963	\$ 76,250

Tract "B" as sold in 1963 included improvements existing on this parcel when the sale was negotiated.

Tract "C" This property owner sold 20 percent interest in the property on March 5, 1958, and an additional 10 percent interest was sold on March 10, 1958. No stamps or sale values were available on these transactions. Of tract "C", 32.86 acres were platted as a portion of the Terrace Meadow Subdivision on November 23, 1959. Also, 39.98 acres were sold for an inferred value of \$23,250 on November 23, 1959, which was also platted as a portion of the Terrace Meadow Subdivision. Three commercial establishments, three churches, and numerous residential homes have been developed on this tract.

<u>Tract "D"</u>	<u>Sale Date</u>	<u>Inferred Value</u>
	8-1956	\$26,250

Tract "D" was sold to an oil company as a choice site for a service station.

Some of the improvements on the above tracts are shown in Figures 2-3 through 2-7.

Comparison of Sale Values and "Before" Value

Only parcels "A", "B" and "D" were considered for this phase of the analysis as the sales for tracts "C" involved some improvements which changed between sales and tract "E" was transferred to a member of the family. The "before" value was assumed to be the same as the appraisal value of \$250 per acre since there were no improvements on tracts "A", "B", or "D" prior to 1948. Based on \$250 per acre the "before" value of these tracts was \$963. The state paid damages of \$100 per acre for separation of tracts "A", "B", "D", and "C-2". The damages paid on tracts "A", "B", and "D" for separation were \$385. The first sale of remainder parcels "A", "B", and "D" was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" values are summarized as follows:



PHOTOGRAPH OF IMPROVEMENTS ON TRACT C



PHOTOGRAPH OF IMPROVEMENTS ON TRACT C

FIGURE 2- 3 - IMPROVEMENTS EXISTING IN 1964



PHOTO OF IMPROVEMENTS ON TRACT C



PHOTO OF IMPROVEMENTS ON TRACT C

FIG. 2-4 - IMPROVEMENTS EXISTING IN 1964

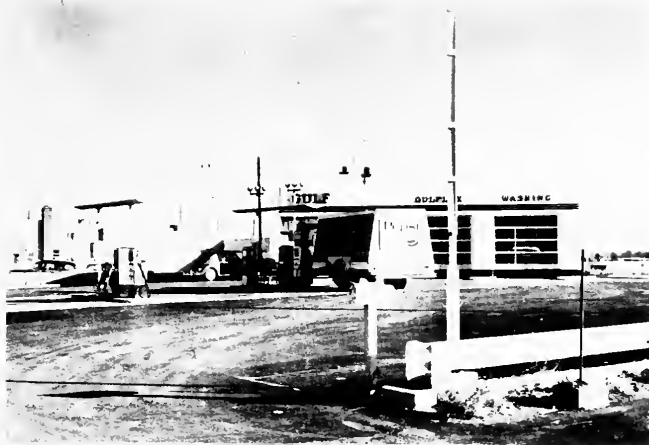


PHOTOGRAPH OF IMPROVEMENTS ON TRACT C

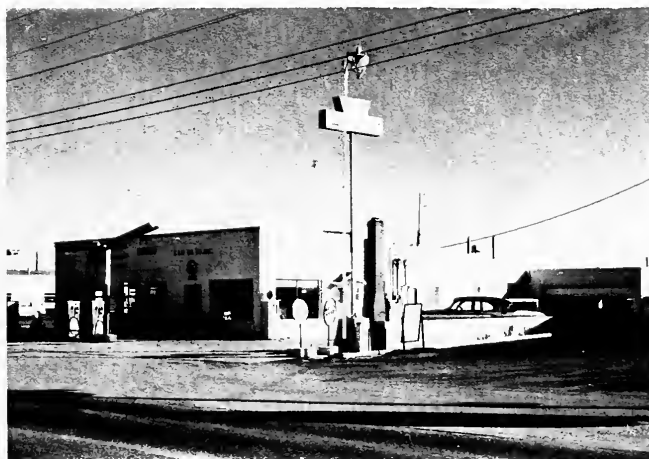


PHOTOGRAPH OF IMPROVEMENTS ON TRACT C

FIGURE 2-5 - IMPROVEMENTS EXISTING IN 1964



PHOTOGRAPH OF IMPROVEMENTS ON TRACT D



PHOTOGRAPH OF IMPROVEMENTS ON TRACT B

FIGURE 2-6 — IMPROVEMENTS EXISTING IN 1964



PHOTO OF IMPROVEMENTS ON TRACT A

FIG.2-7 - IMPROVEMENTS EXISTING IN 1964

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
"A"	\$ 750	\$ 583
"B"	2,250	1,170
"D"	<u>750</u>	<u>209</u>
Total	\$3,750	\$1,962

"Before" value of 3.85 acres	\$ 963
Damages for 3.85 acres separated	<u>385</u>
Apparent "after" value	\$ 578
Sale prices	3,750
"Adjusted" sale price	<u>1,962</u>
Difference ("adjusted" less apparent + "after")	\$1,384

An analysis of the last sales of tracts "A" and "D" was also made before improvements were constructed on them. The "adjusted" sale values of these last sales together with a comparison with the apparent "after" values are as follows:

<u>Tract</u>	<u>Sale Price and Date</u>	<u>"Adjusted" Price</u>
"A"	-\$42,000 (10-62)	\$10,800
"D"	<u>26,250 (8-56)</u>	<u>6,800</u>
	\$68,250	\$17,600

"Before" value of 2.00 acres	\$ 500	\$ 500
Settlement for 2.00 acres	<u>200</u>	<u>200</u>
Apparent "after" value	\$ 300	\$ 300
Sale prices	1,500(first)	68,250 (last)
"Adjusted" sale price	<u>790(first)</u>	<u>17,600 (last)</u>
Difference ("adjusted" less apparent "after")	+\$ 490(first)	+\$17,300 (last)

Summary

From this case study it is concluded that the property received a considerable enhancement since the apparent "after" value of tracts "A", "B", and "D" was \$578, but the "adjusted" first sale prices showed that the property owner received \$1,962 ("adjusted" sale price) for these remainder parcels. Later sales of properties "A" and "D" showed the owner received "adjusted" sale prices \$17,600 for property with an apparent "after" value of \$300 in 1948 while first sales of these same lands had an "adjusted" sale price of only \$790.

CASE STUDY NO. 3

Location

The subject property was located just north of Wildcast Creek and in the path of the U.S. 31 By-pass (see Figure 3-1.)

"Before" Data

The property was a 6.70 acre parcel prior to the taking of 3.44 acres for right-of-way of the Kokomo By-pass. An improvement existed on this property. Since the property was not transferred from 1945 to 1947, a "before" sale value was not available.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass was constructed as a two-lane facility because the traffic volume at that time did not warrant a four-lane facility. Enough right-of-way was acquired in the initial taking to permit the addition of two more travel lanes when traffic volumes warranted this addition. The final by-pass was planned as a four-lane divided facility with little or no control of access.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964
FIGURE 3-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the part taken and the "after" sale tracts is illustrated in Figure 3-2. Damages paid in the final settlement are summarized as follows:

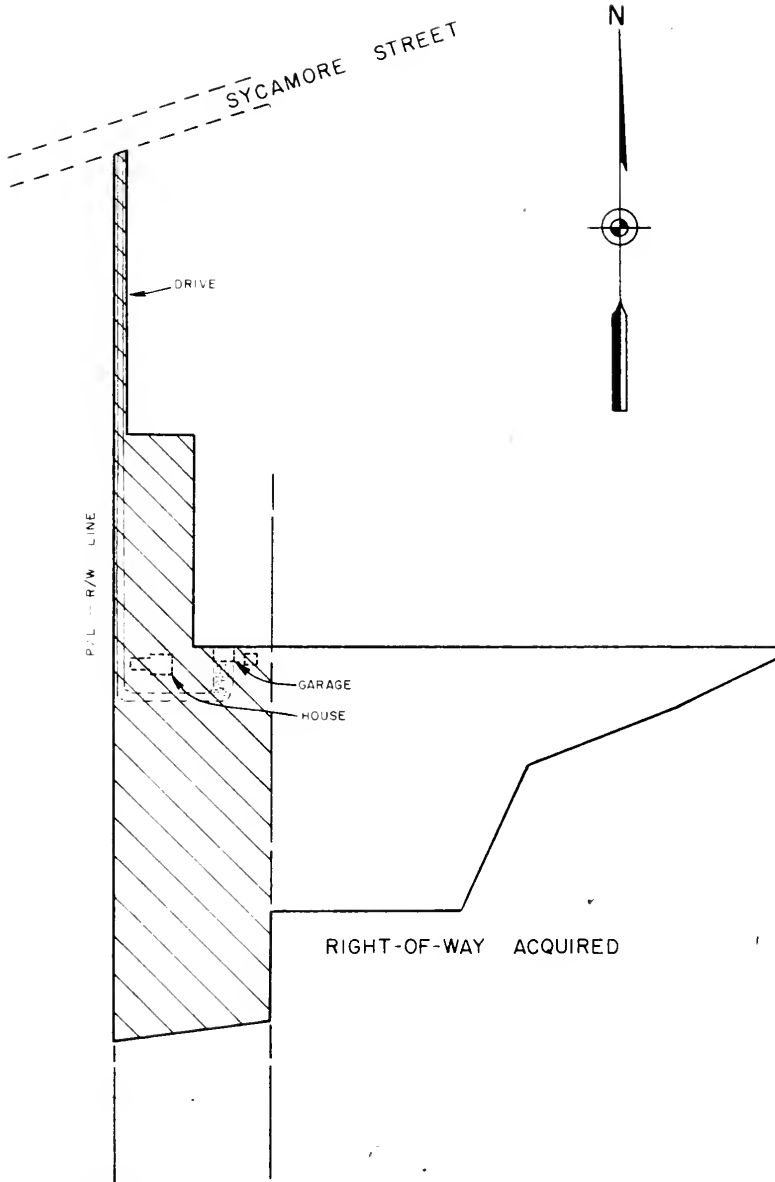
land in R/W, 3.44 acres	\$ 2,656
buildings to be moved	10,584
improvements to land	1,460
other	300
	<hr/>
Total amount paid	\$15,000

"After" Data

The first sale of the remainder parcel (approximately 3.26 acres) was in June, 1949, for an inferred value of \$2,000. Subsequent sale of this remainder parcel are as follows:

<u>Sale Date</u>	<u>Acreage</u>	<u>Sale Price</u>
7-1954	3.26	\$ 4,000 (stated)
7-1956	3.26	10,500 (stated)
10-1962	3.26	10,500 (stated)

An improvement was added to the subject property prior to the sale in 1956. See Figure 3-3 for a photograph of the present improvement.



SUBJECT PROPERTY SHOWING RIGHT-OF-WAY TAKEN
FIGURE 3-2



PHOTOGRAPH OF IMPROVEMENT

FIGURE 3-3 - IMPROVEMENTS EXISTING IN 1964

Comparison of Sale Value and "Before" Value

For this phase of the analysis the remainder parcel of 3.26 acres was assumed to have been worth \$770 per acre in 1948. The 3.26 acres, therefore, had a "before" value of \$2,510. The first sale of the remainder parcel was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" value is summarized as follows:

<u>Parcel</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
3.26 acres	\$2,000	\$1,270
"Before" value		\$2,510
Sale price		2,000
"Adjusted" sale price		<u>1,270</u>
Difference ("adjusted" less "before")	-	\$1,240

The last sale of the remainder parcel without an improvement was also analyzed. The "adjusted" sale values of the last sale together with a comparison with the "before" value are as follows:

<u>Parcel</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
3.26 acres	\$4,000 (7-1954)	\$1,180

"Before" value	\$2,510
Sale price	4,000
"Adjusted" sale price	<u>1,180</u>
Difference ("adjusted" less "before") -	\$1,330

Summary

This case study indicates that this property owner may have been slightly underpaid for the property taken for the right-of-way of the highway improvement. This apparent loss may have resulted from assumptions made in the analysis. For example, the appraised value for the land may have been high which could have resulted in an inflated value when applied to the remainder parcel. The land in this immediate vicinity seems also to have been in low demand as it has been slow to develop.

CASE STUDY NO. 4

Location

The subject property was located south of Sycamore Street and east of the U.S. 31 By-pass (see Figure 4-1).

"Before" Data

The property was a 64.29 acre farm. The entire parcel was purchased for an inferred value of \$8,250 on February 8, 1945. Improvements existed on the property at the time of this sale.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was constructed as a two-lane highway with little or no control of access. Sufficient right-of-way was acquired in the initial taking to permit the addition of a second two lanes to the planned four-lane facility.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 4-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the portion taken is illustrated in Figure 4-2. Damages paid in the final settlement are summarized as follows:

construction of fence	\$144
land in R/W, 1.6 acres	606
corner cut	<u>50</u>
Total amount paid	\$800

"After" Data

The first sale of the described tracts are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
"A"	3-1955	0.81	\$14,750
"B"	5-1963	<u>56.76</u>	<u>16,750</u>
Total		57.57	\$31,500

Tract "A" This tract was sold to an oil company as a choice site for a service station.

Tract "B" An industrial establishment purchased this property which is used as a recreational area for the employees.

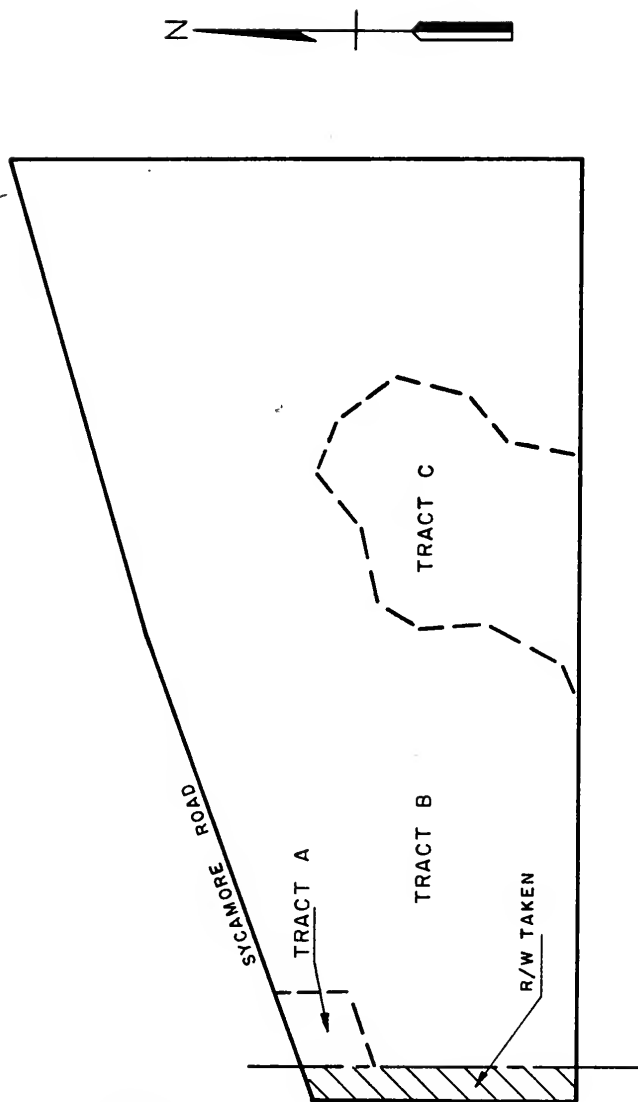


FIG.42-PLAT OF SUBJECT PROPERTY SHOWING RIGHT-OF-WAY TAKEN

Tract "C" This portion of the property is still possessed by the original property owner. The improvement on the original 64.29 acres is on this tract.

See Figure 4-3 for a photograph of the improvement on tract "A".

Comparison of Sale Value and "Before" Value

The sale of tracts "A" and "B" was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" values are summarized as follows:

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
"A"	\$14,750	\$4,200
"B"	16,750	3,390
Total	\$31,500	\$7,590
"Before" value of entire property (1945 purchase price)		\$ 8,250
Settlement for part taken		800
Apparent "after" value		\$ 7,450
Sale price of tracts "A" & "B"		31,500
"Adjusted" sale price		7,590
Difference ("adjusted" less apparent "after")		+ \$ 140



IMPROVEMENTS LOCATED ON TRACT A

FIG.4-3-IMPROVEMENTS EXISTING IN 1964

Summary

The above indicates that the property owner has already received, in "adjusted" value, slightly more than his purchase price for the entire property through the sale of tracts "A" and "B". The property owner still possesses tract "C" on which the original improvements in the property are located.

CASE STUDY NO. 5

Location

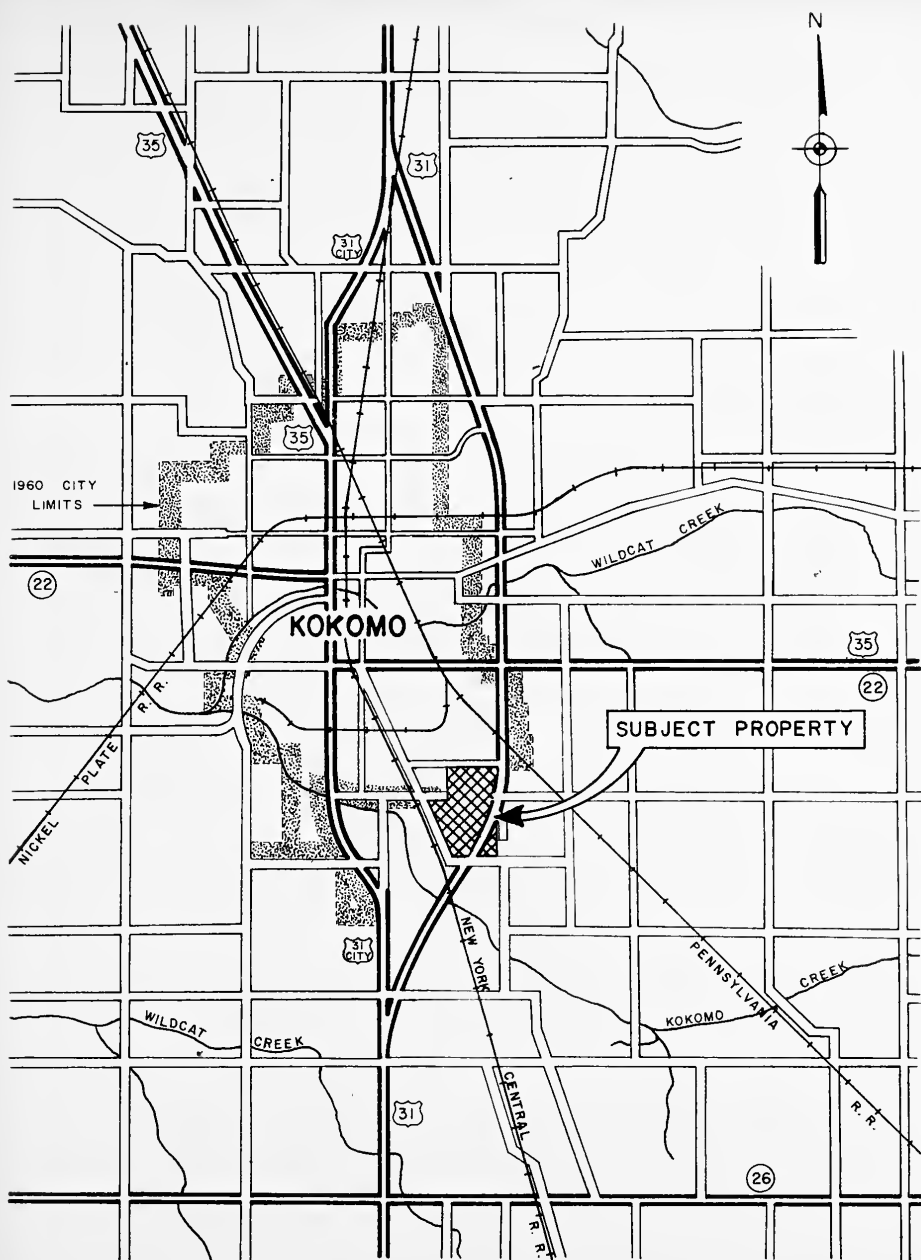
The subject property was located near the southeast edge of Kokomo. The U.S. 31 By-pass separated this property (see Figure 5-1).

"Before" Data

The property was a 278 acre farm with improvements. In September, 1946, the acreage was divided among the owner's sons. The title to parcel "A", which contained the improvements, was transferred to two of the sons, jointly. Parcel "B" was transferred to a third son. Since this property was not sold from 1945 through 1947, a "before" value was not available.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was opened to traffic. The facility was constructed as a two-lane highway with little or no control of access. Sufficient right-of-way was acquired in the initial taking to permit the addition of two more travel lanes to complete the planned four-lane divided by-pass.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 5-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the property showing the portion taken is illustrated in Figure 5-2. Damages paid in the final settlement are summarized as follows:

Parcel "A"

land in R/W, 3.05 acres	\$1,525
fence and trees	575
damages due to irregular shape	150
	<hr/>
Total	\$2,250

Parcel "B"

land in R/W, 8.94 acres	\$3,260
fence to be constructed	1,010
land separation	4,000
damages due to irregular shape	150
	<hr/>
Total	\$ 8,420

Total settlement damages	\$10,670
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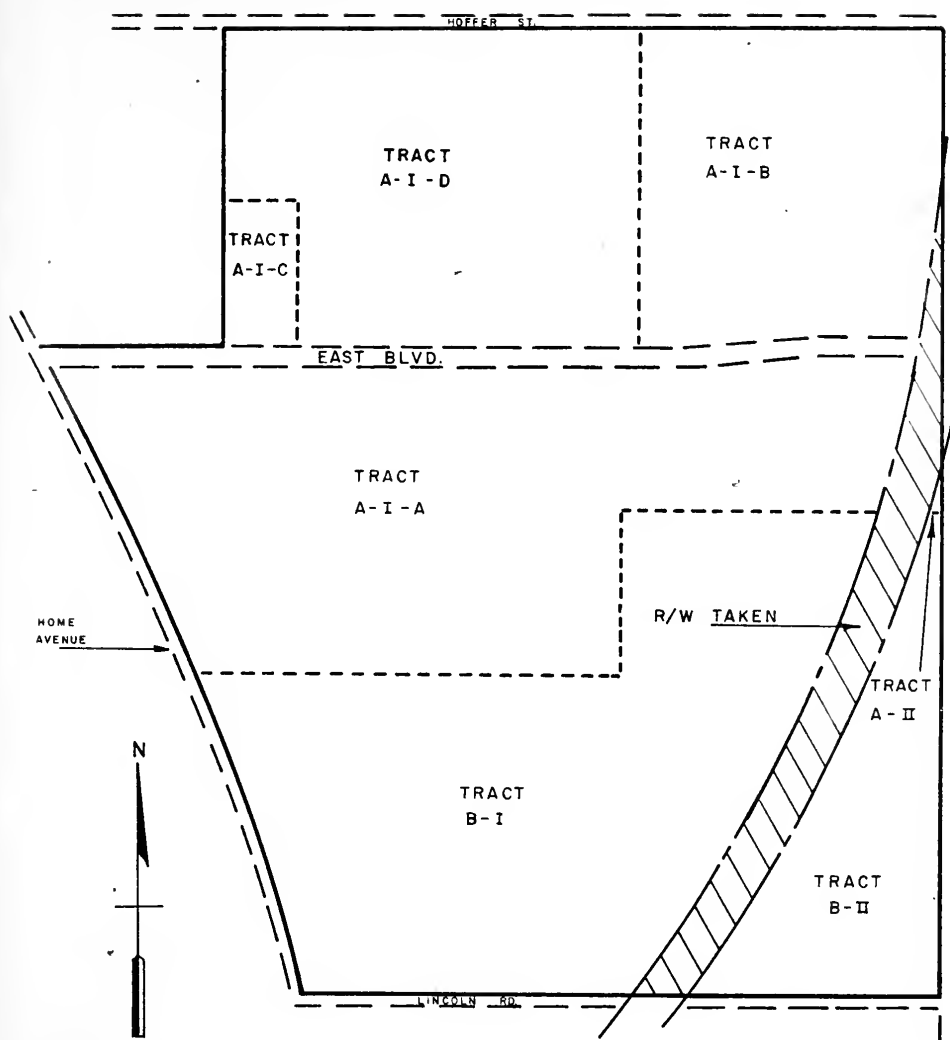


FIG.5-2-RIGHT-OF-WAY ACQUIRED AND LOCATION OF TRACTS SOLD

"After" Data

The initial sales after the construction of the by-pass are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
A-I-A	3-1955	80.62	\$161,250
B-I	3-1955	77.48	154,750
B-II	12-1959	26.70	128,750
A-II	12-1959	0.30	1,000
A-I-B	6-1962	38.21	139,750
A-I-C	8-1962	4.55	24,750
Totals		227.86	\$610,250

Tracts A-I-A and B-I were sold to an industrial firm in 1956. A large industry was constructed on these two tracts.

Tracts A-II and B-II were purchased by representatives from an industry. A large factory was developed on these two parcels and on the adjacent property to the east of parcels A-II and B-II.

A community shopping center was developed on tract A-I-B, and tract A-I-C was developed with commercial establishments.

See Figures 5-3 through 5-6 for photographs of improvements on the above tracts.



PHOTOGRAPH OF IMPROVEMENTS ON TRACT A-I-B



PHOTOGRAPH OF IMPROVEMENTS ON TRACT A-I-B

FIG.5-3 - IMPROVEMENTS EXISTING IN 1964



PHOTO OF IMPROVEMENTS ON TRACTS A-I-A & B-I

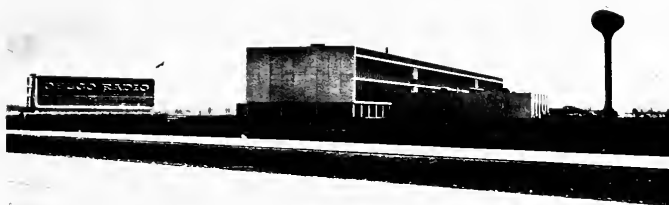


PHOTO OF IMPROVEMENTS, PART OF WHICH ARE
LOCATED ON TRACT B-II

FIG.5-4-IMPROVEMENTS EXISTING IN 1964



IMPROVEMENTS LOCATED ON TRACT A-I-B



IMPROVEMENT LOCATED ON TRACT A-I-C

FIG. 5-5 - IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED ON TRACT A-I-C



IMPROVEMENT LOCATED ON TRACT A-I-C

FIG.5-6 - IMPROVEMENTS EXISTING IN 1964

Comparison of Sale Value and "Before" Value

Only tract "B" and part of tract "A" were considered for this phase of the analysis as tract A-I-D has improvements on it which have not been evaluated. The "before" value in dollars per acre was assumed to be the same as the appraisal value. Based on the appraisal value of \$365 per acre, the "before" value of tract "B" was \$41,300, and at \$500 per acre the "before" value of tracts A-I-A, A-I-B, A-I-C, and A-II was \$61,840. The remainder parcel sales were adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" values are summarized as follows:

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted Price"</u>
B-I	\$154,750	\$ 44,000
B-II	<u>128,750</u>	<u>39,700</u>
Total	\$283,500	\$ 73,700
"Before" value of tract "B"		\$ 41,300
Settlement for part taken		<u>8,420</u>
Apparent "after" value		\$ 32,880
Sale Price		283,500
"Adjusted" sale price		<u>73,700</u>
Difference ("Adjusted" less apparent "after")	+	\$ 40,820

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
A-I-A	\$161,250	\$ 46,400
A-I-B	139,750	29,200
A-I-C	24,750	5,140
A-II	1,000	230
Total	\$326,750	\$ 80,970

"Before" value of 123.68 acres (tract "A") \$ 61,840

Settlement damages for separation 150

Apparent "after" value \$ 61,690

Sale price 326,750

"Adjusted" sale price 80,970

Difference ("Adjusted" less apparent "after") + \$ 13,280

Summary

The results of this analysis show that the property owners of these tracts were enhanced by a value of \$60,100 because of the location of the U.S. 31 By-pass. This case study further indicates that a highway improvement near an urban area usually has a positive effect on land value.

CASE STUDY NO. 6

Location

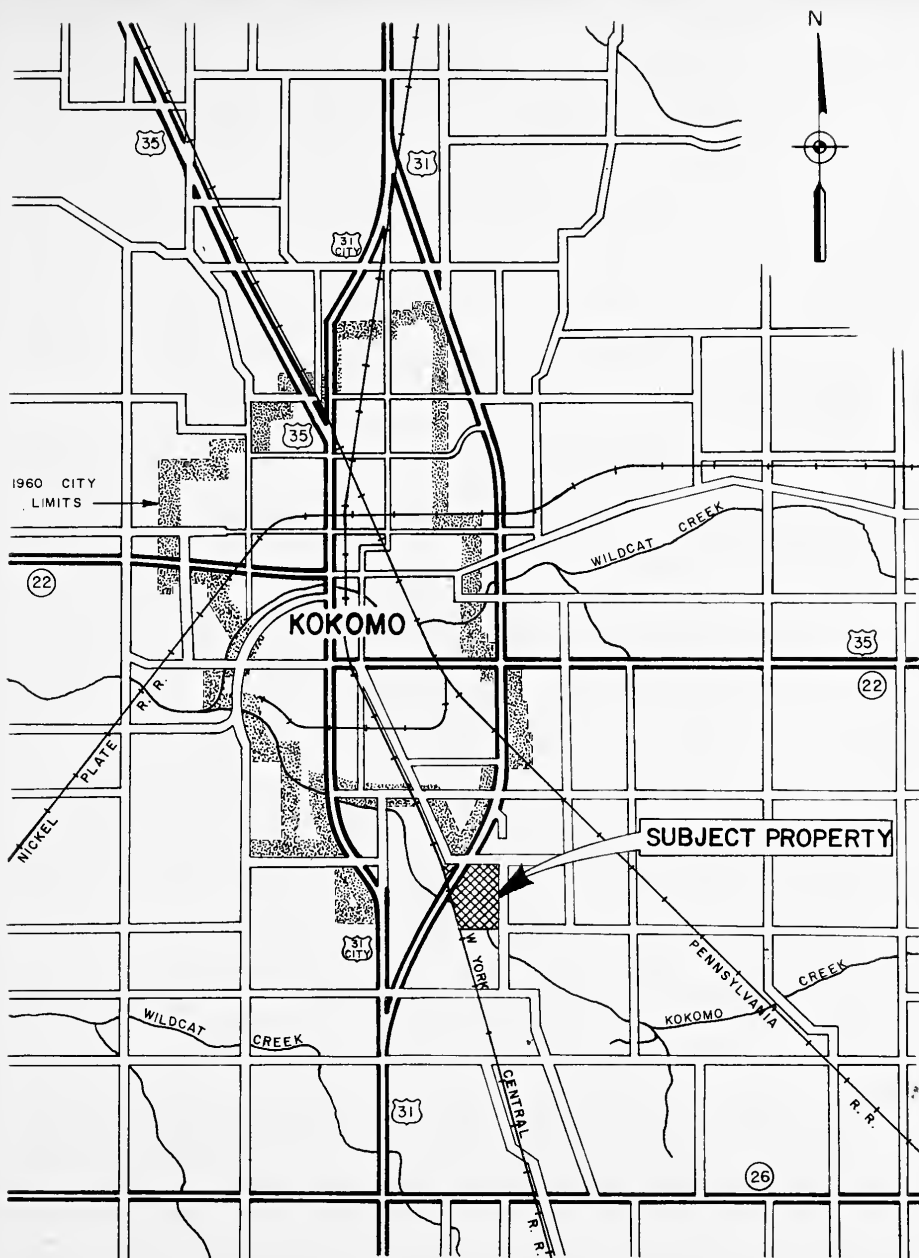
The subject property was located on both sides of the U.S. 31 By-pass just south of Lincoln Road (see Figure 6-1).

"Before" Data

The property consisted of 138.75 acres (including approximately 4 acres in public roads) on which a set of buildings in poor condition were situated. The entire property was sold in October, 1947, for \$18,000 or \$130 per acre.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was opened as a two-lane highway with little or no control of access. Sufficient right-of-way was acquired in the initial taking to permit the addition of a second two lanes to the planned four-lane divided facility.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 6-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the portion taken is illustrated in Figure 6-2. Damages paid in the final settlement are summarized as follows:

land in R/W, 7.8 acres	\$ 2,340
fence to be constructed	900
trees	160
damages due to shape	100
damages due to separation	<u>2,500</u>
Total amount paid	\$ 6,000

"After" Data

The initial sale of the described tracts is as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Sale Price</u>
I-A	6-1959	20.28	\$ 50,000
I-B	7-1959	6.16	12,312
I-C	1-1960	78.37	140,147
I-D	1959	4.5	6,840
II-A	3-1963	16.55	82,500
II-B	Sale Pending	<u>0.94</u>	<u>50,000</u>
Total		126.80	\$341,799

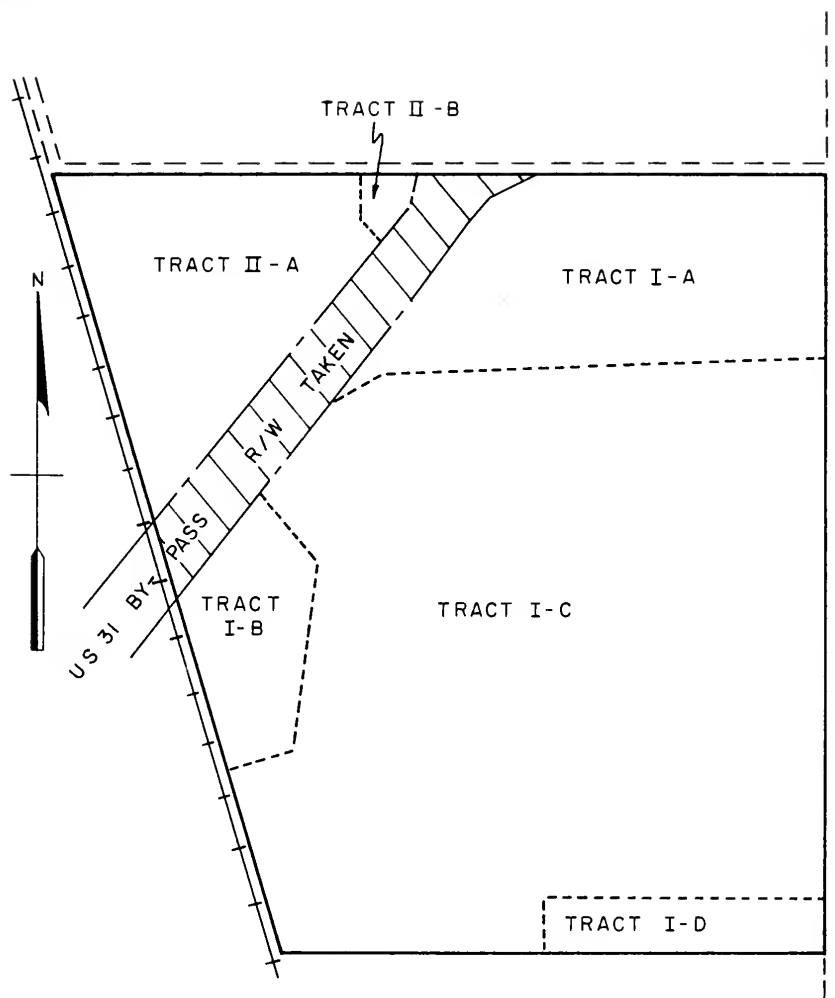


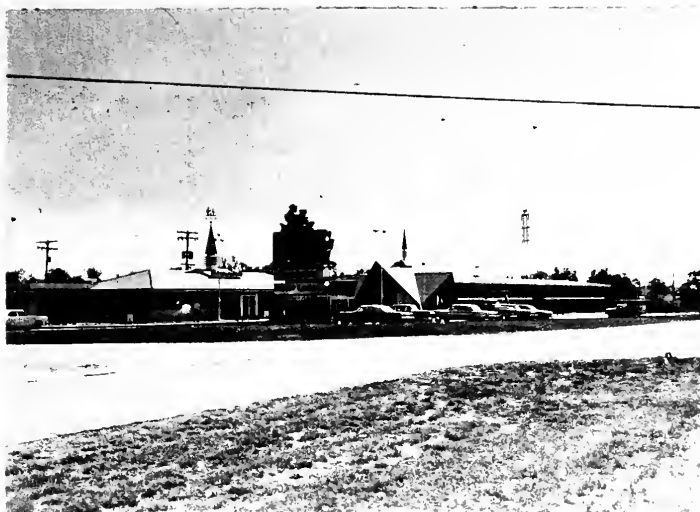
FIGURE 6-2 - RIGHT-OF-WAY ACQUIRED AND LOCATION OF TRACTS SOLD

- Tract I-A This was a cash transaction
- Tract I-B This also was a cash transaction.
- Tract I-C The contract for this sale specified that the sale price was to be paid in ten equal annual installments without interest.
- Tract I-D This was sold on land contract.
- Tract II-A This transaction involved the exchange of land for securities valued at the amount of the sale price. The improvements that existed on this property were considered to have no value.
- Tract II-B The offered price is \$50,000 cash; however, the owner wanted the payment to be made over a period of years.

There were no improvements made to tract I-A until after the 1962 sale. A motel and restaurant were subsequently constructed on it (see Figure 6-3). The remaining tracts had not been developed as of January 1, 1964.

Comparison of Sale Value and "Before" Value

The sale prices were adjusted to 1948 so that all monetary values were on a comparable basis. The sale prices were adjusted by using the percentage increase of land value from band V as shown in Figure 61. The "adjusted" values are summarized as follows:



PHOTOGRAPH OF IMPROVED TRACT I - A

FIG. 6-3-IMPROVEMENTS EXISTING IN 1964

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
I-A	\$ 50,000	\$ 12,100
I-B	12,312	2,960
I-C	140,147	32,600
I-D	6,840	1,650
II-A	82,500	16,000
II-B	50,000	9,280
Total	\$341,799	\$ 74,590

"Before" value	\$ 18,000
Settlement for part taken	6,000
Apparent "after" value	\$ 12,000
Sale price	341,799
"Adjusted" sale price	74,590
Difference ("Adjusted" less Apparent + "after")	\$ 62,590

Summary

Since all the parcels of land have been transferred, a detailed analysis of the entire 138.75 acres was possible. From this study it is concluded that the property owner received a sizeable enhancement since the apparent "after" value was \$12,000, but the "adjusted" sale price showed that the property owner received \$74,590 for the remainder parcels.

CASE STUDY NO. 7

Location

The subject property was located on the west side of the U.S. 31 By-pass between Jefferson and Sycamore Streets (see Figure 7-1).

"Before" Data

The property was a 6.28 acre parcel with improvements. Since the subject property was not transferred from 1945 to 1947, a "before" sale value was not available.

Description of Highway Improvement

In 1949 - 1950 the U.S. 31 By-pass at Kokomo was constructed as a two-lane highway with little or no control of access. Sufficient right-of-way was acquired in the initial taking to permit the addition of a second two lanes to the planned four-lane divided facility when traffic volumes warranted this addition.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 7-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property is shown in Figure 7-2. Damages paid in the final settlement are summarized as follows:

fence to be constructed	\$ 20
land in R/W, 0.24 acres	515
raspberry patch	25
fruit trees	110
hedge	30
garden	100
	<hr/>
Total amount paid	\$ 800

"After" Data

The first sale of the described tracts are as follows:

<u>Tract</u>	<u>Sale Price</u>	<u>Acreage</u>	<u>Inferred Value</u>
"A"	8-1953	0.93	\$ 4,750
"B"	8-1953	0.73	11,750
"C"	9-1953	0.74	No information
"D"	10-1953	0.74	1,250
"E"	2-1954	0.53	1,250
"F"	3-1956	0.51	1,250
"G"	4-1956	0.56	4,250
"H"	5-1959	1.54	2,750
		<hr/>	<hr/>
Totals		6.28	\$27,250

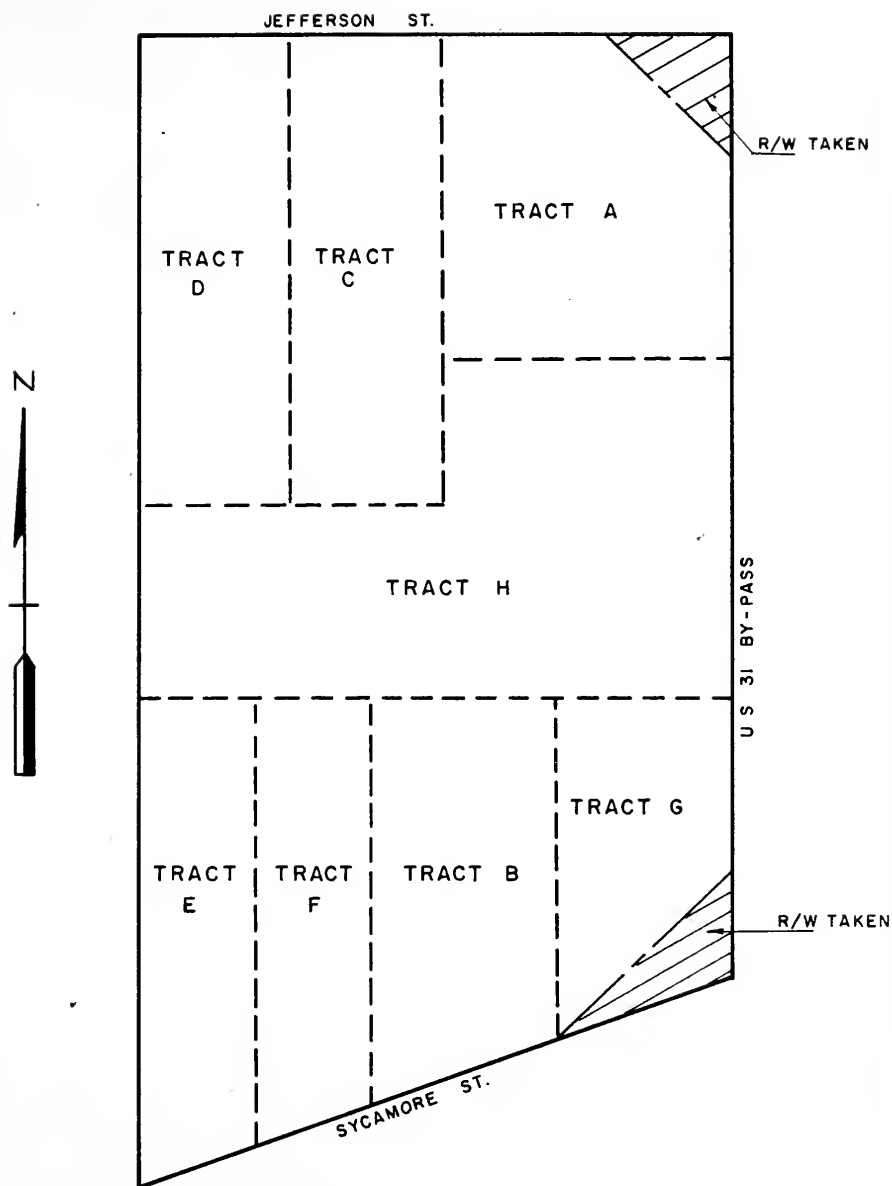


FIG. 7-2-PLAT OF SUBJECT PROPERTY SHOWING R/W TAKEN

An improvement existed on tract "B" when the transfer of property was negotiated on August 31, 1953.

Subsequent sales were as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
"B"	8-1959	\$ 11,250
	2-1962	No Information
"C"	6-1955	\$ 1,250
	6-1958	No Information
"D"	2-1963	No Information
	3-1963	\$ 5,750
"E"	4-1954	No Information
	9-1954	\$ 1,250
	1-1956	10,250

An improvement existed on tract "E" when the sale was made in 1956. Improvements on the above tracts are shown in Figures 7-3 through 7-6.

Summary

Since no suitable "before" property value was available, few conclusions can be drawn as yet from this property. The land use of this property has generally remained residential. Tract "D" does show an increase in land value from \$1,250 in



IMPROVEMENT LOCATED ON TRACT A



IMPROVEMENT LOCATED ON TRACT A

FIG.7-3-IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED ON TRACT B



IMPROVEMENT LOCATED ON TRACT C

FIG.7-4-IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED ON TRACT E



IMPROVEMENT LOCATED ON TRACT D

FIG. 7-5 - IMPROVEMENTS EXISTING IN 1964



IMPROVEMENT LOCATED ON TRACT F

FIG. 7-6 - IMPROVEMENT EXISTING IN 1964

1953 to \$5,750 in 1963. When adjusted by the land value increases found in Figure 61 from land V, this 1963 sale price is \$3,760 in terms of 1953 values. A significant increase in value of this land is therefore indicated.

CASE STUDY NO. 8

Location

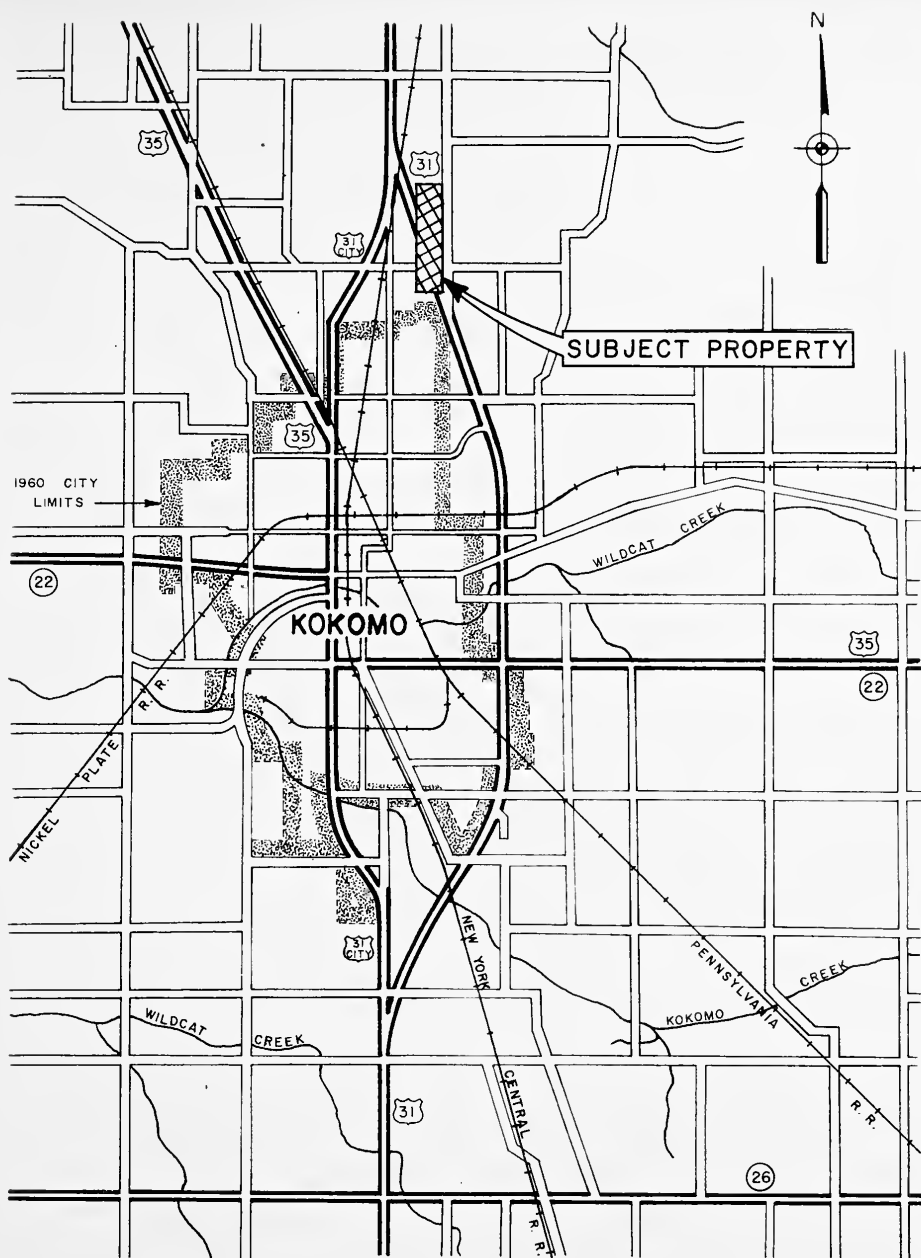
The subject property lies on both sides of the U.S. 31 By-pass in the vicinity of Smith Road (see Figure 8-1).

"Before" Data

The property was an 120 acre farm with improvements in 1947. Since the property was not transferred from 1945 to 1947, a "before" sale value was not available.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was constructed as a two-lane facility because traffic volumes at that time did not warrant a four-lane facility. Enough right-of-way was purchased in the initial taking, however, for the addition of two more travel lanes. The final by-pass was planned as a four-lane divided facility with little or no control of access.



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 8-1

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the portion taken is illustrated in Figure 8-2. Damages paid in the final settlement are summarized as follows:

fence to be moved	\$ 220
fence to be constructed	910
land in R/W, 9.78 acres	3,420
corner cuts	200
fences to be rearranged	250
separation of land	<u>2,000</u>
Total amount paid	\$ 7,000

"After" Data

The first sale of the described tracts are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
"A"	12-1949	2.0	\$ 1,250
"B"	3-1961	2.0	4,750
"C"	11-1961	<u>4.01</u>	<u>9,750</u>
Total		8.01	\$ 15,750



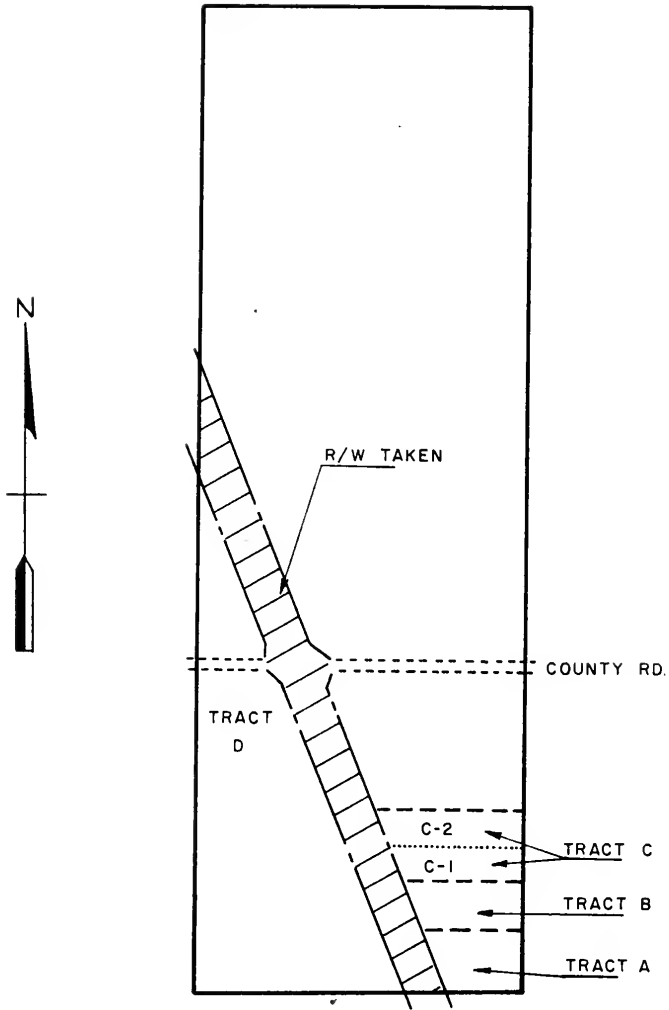


FIG.8-2 - RIGHT-OF-WAY ACQUIRED AND LOCATION OF TRACTS SOLD

No improvements existed on tracts "A", "B", and "C" at the date of sale.

The subsequent sales of the tracts are as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
"A"	11-1951	\$ 3,750

Tract "A" had no improvement at the date of this sale.

<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
C-1	9-1962	No Information
C-2	8-1963	\$ 4,750

Tract "C" was divided into two parcels, C-1 and C-2. No improvements existed on these parcels at the date of the sales.

A commercial improvement has been built on tract "D", but no sale of this parcel was recorded. This could indicate that the site has been leased.

Photos of the improvements on the above tracts are shown in Figures 8-3 and 8-4.

Comparison of Sale Value and "Before" Value

Tracts "A", "B", and "C" were considered for this portion of the analysis. The "before" value was assumed to be the same as the appraisal value of \$350 per acre. No improvements existed on tracts "A", "B", or "C" prior to 1948. At \$350 per acre the "before" value of tracts "A", "B", and "C" was



IMPROVEMENT LOCATED ON TRACT B



IMPROVEMENT LOCATED ON TRACT D

FIG.8-3 - IMPROVEMENTS EXISTING IN 1964



IMPROVEMENTS LOCATED ON TRACT C-1



IMPROVEMENTS LOCATED ON TRACT C-2

FIG.8-4-IMPROVEMENTS EXISTING IN 1964

\$2,800. The first sale of parcels "A", "B", and "C" was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" sale values are summarized as follows:

<u>Tracts</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
"A"	\$ 1,250	\$ 707
"B"	4,750	1,040
"C"	9,750	2,080
Total	\$ 15,750	\$ 3,827
"Before" value		\$ 2,800
Sale price		15,750
"Adjusted" sale price		3,827
Difference ("Adjusted" less "Before")	+ \$ 1,027	

The subsequent sale of tract "A" in 1951 was also analyzed:

<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
"A"	\$ 3,750	\$ 1,500
"Before" Value (2.0 acres)	\$ 700	\$ 700
Sale price	1,250 (1949)	3,750 (1951)
"Adjusted" sale price	707 (1949)	1,500 (1951)
Difference "Adjusted" less "before")	+ \$ 7 (1949)+\$ 300 (1951)	

The above indicates an increase in enhancement of tract "A" by almost \$800 between 1949 and 1951 after adjusting the sale price to a 1948 value.

Summary

From this case study it is concluded that the property owner received some enhancement. The apparent "after" value of tracts "A", "B", and "C" was \$2,800, but the "adjusted" sale price showed that the property owner received \$3,827 for these remainder parcels. The value of tract "A" was also found to increase almost \$800 in 1948 value between the years 1949 and 1951.



CASE STUDY NO. 9

Location

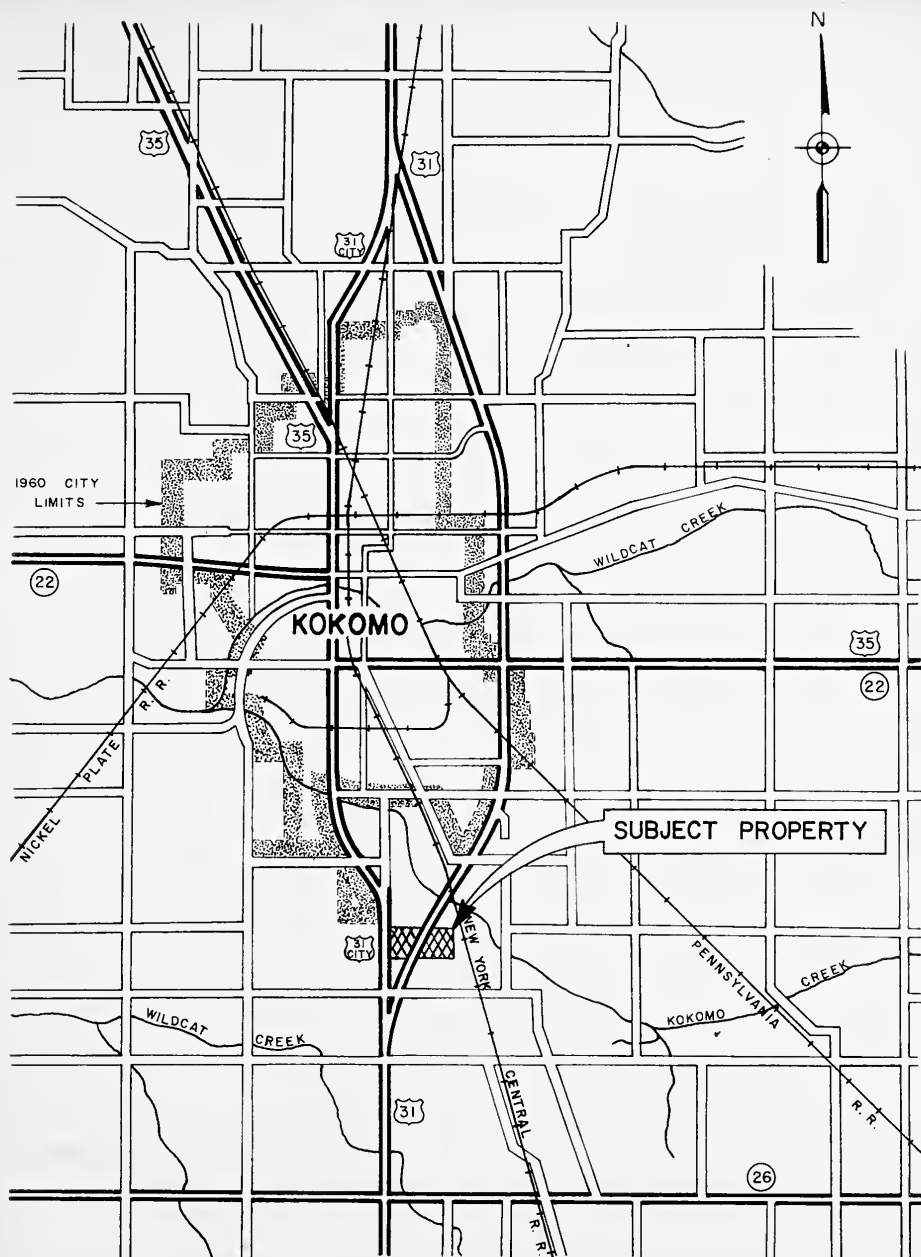
The subject property was located at the south edge of Kokomo. The U.S. 31 By-pass separated this property (see Figure 9-1).

"Before" Data

The property was a 62.2 acre parcel prior to the construction of the by-pass. In August, 1946, tract I-A (5.0 acres) was sold from the 62.2 acre parcel for an inferred value of \$2,000. Also in August, 1946, the remaining 57.2 acres of parcel I were transferred to the surviving sons upon the death of the original owner. A "before" sale value was not available since there was no monetary transaction when the 57.2 acres were transferred.

Description of Highway Improvement

In 1950 the U.S. 31 By-pass at Kokomo was constructed as a two-lane facility because traffic volumes at that time did not warrant a four-lane facility. Enough right-of-way



ROAD NETWORK IN THE VICINITY OF KOKOMO, INDIANA, IN 1964

FIGURE 9-1

was purchased in the initial taking, however, for the addition of two more travel lanes. The final by-pass was planned as a four-lane divided facility with little or no control of access.

Part Taken

At the time of this taking the Indiana State Highway Commission made an appraisal of only the portion of the property taken for the right-of-way of the improvement. A plat of the subject property showing the portion taken is illustrated in Figure 9-2. Damages paid in the final settlement are summarized as follows:

land in R/W, 5.4 acres	\$ 1,600
separation of land	1,200
fence to be constructed	<u>700</u>
Total amount paid	\$ 3,500

"After" Data

The first sales following the construction of the by-pass are as follows:



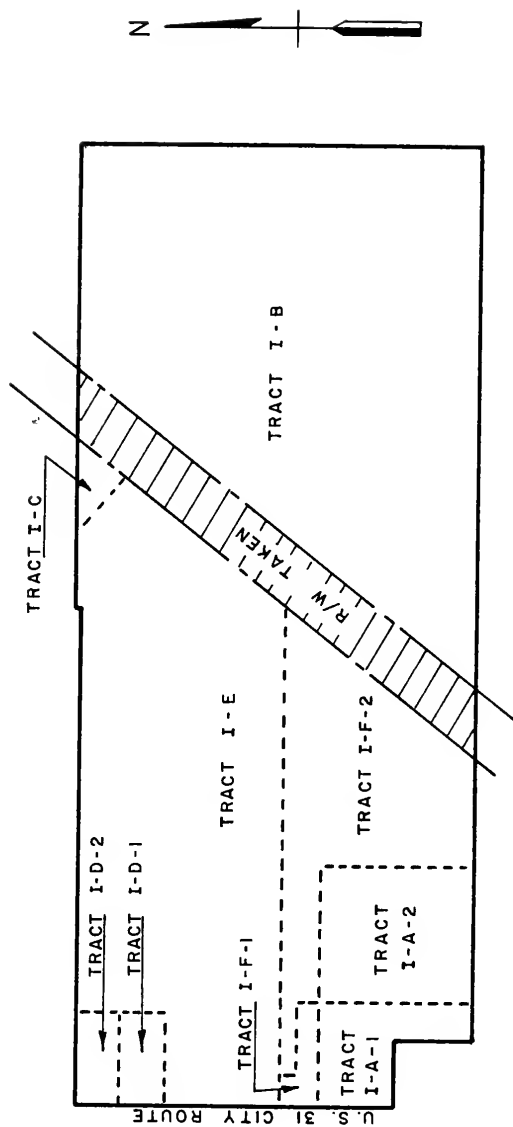


FIG. 9-2 - RIGHT-OF-WAY ACQUIRED AND LOCATION OF TRACTS SOLD

<u>Tract</u>	<u>Sale Date</u>	<u>Acreage</u>	<u>Inferred Value</u>
I-A (includes I-A-1 and I-A-2)	7-1948	5.00	\$ 12,250
I-B	10-1950	21.58	12,250
I-C	4-1953	0.38	750
I-D	2-1956	1.61	4,750
I-E	6-1958	17.75	49,750
I-F (includes I-F-1 and I-F-2)	3-1961	<u>6.70</u>	<u>10,500</u>
Total		57.02	\$ 92,950

The subsequent sales of the tracts were as follows:

<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
I-B	2-1956	No information
	2-1958	No information
	3-1958	No information

In November, 1959, one tenth of the interest in tract I-B was sold, and in the same month the parcel was platted as a portion of the Terrace Meadows Subdivision.

<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
I-C	9-1954	\$ 2,250
	6-1957	27,000

An improvement existed on tract I-C prior to the sale in June 1957.



<u>Tract</u>	<u>Sale Date</u>	<u>Inferred Value</u>
I-D-1	2-1956	\$ 3,750
	9-1957	5,750
I-D-2	10-1957	\$ 4,750
	10-1958	9,750

Tract I-D was subdivided into two parcels - D-1 of 0.80 acres and D-2 of 0.81 acres.

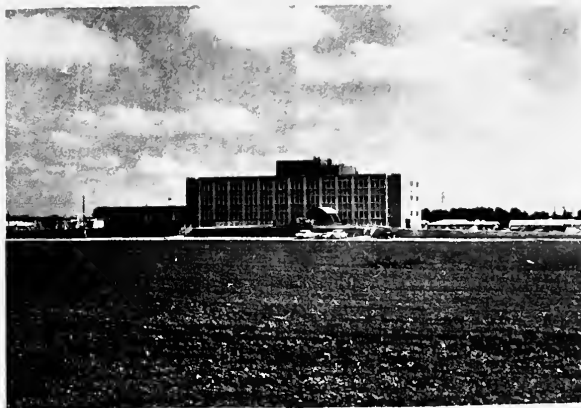
In April, 1962, 10.0 acres from tracts I-A and I-F were sold for a stated value of \$40,000. These 10.0 acres are included in tracts I-A-2 and I-F-2.

Some of the subsequent improvements on the above tracts are shown in Figures 9-3 and 9-4.

Comparison of Sale Value and "Before" Value

The "before" value was assumed to be comparable to the appraisal value of \$300 per acre since there were no improvements on this property. Based on \$300 per acre, the "before" value of the 62.2 acre parcel was \$18,700. The first sale of the remainder parcels was adjusted to a 1948 value by using the percentage change of land value from band V in Figure 61. The "adjusted" values are summarized as follows:





IMPROVEMENT LOCATED ON TRACT I-E



IMPROVEMENT LOCATED ON TRACT I-D-2

FIG.9-3- IMPROVEMENTS EXISTING IN 1964





IMPROVEMENT LOCATED ON TRACT I-F-2



IMPROVEMENT LOCATED ON TRACT I-A-2

FIG. 9-4 - IMPROVEMENTS EXISTING IN 1964



<u>Tract</u>	<u>Sale Price</u>	<u>"Adjusted" Price</u>
I-A	\$ 13,950	\$ 11,400
I-B	13,250	4,680
I-C	750	245
I-D	4,750	1,300
I-E	49,750	12,200
I-F	10,500	2,300
Total	\$ 92,950	\$ 32,125

"Before" value	\$ 18,700
Settlement for part taken	<u>3,500</u>
Apparent "after" value	\$ 15,200
Sale price	30,950
"Adjusted" sale price	<u>32,125</u>
Difference ("Adjusted" less Apparent "after")	+ \$ 16,925

An analysis of the last sale of portions of this property prior to the addition of improvements is as follows:

<u>Tract</u>	<u>Last Sale Price</u>	<u>"Adjusted Price</u>
I-C	\$ 2,250	\$ 660
I-D-1	5,750	1,450
I-D-2	9,750	2,350
I-A-2 & I-F-2	40,000	8,250
Total	\$ 57,750	\$ 12,710

"Before" value (12.0 acres at \$300 per acre)	\$ 3,600	\$ 3,600
Sale price	25,000 (first)	82,500 (last)
"Adjusted" sale price	<u>13,245 (first)</u>	<u>12,710 (last)</u>
Difference ("Adjusted" less "before")	+ \$ 9,645 (first)	+\$ 9,110 (last)

Summary

From this study it is concluded that the property owner received a substantial enhancement since the apparent "after" value was \$15,200, but the "adjusted" first sale prices showed that the property owner received \$32,125 for the remainder parcels. The last sale of portions of the property showed no additional enhancement when compared with the first sales.



